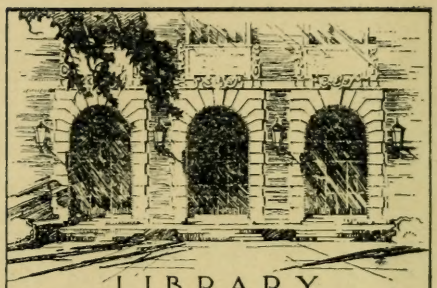

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Papilio Urticæ
small
Tortoise-shell Butterfly.

Chrysalis.

Caterpillar or Larva
of the
Tortoise shell Butterfly.

Published November 1, 1818, by R. Hunter, St. Paul's Church Yard, London.

DIALOGUES

ON

ENTOMOLOGY,

IN WHICH

THE FORMS AND HABITS OF INSECTS

ARE

FAMILIARLY EXPLAINED.

ILLUSTRATED WITH TWENTY-FIVE ENGRAVINGS.

We trace in Nature's most minute design
The signature and stamp of power divine;
Contrivance intricate, express'd with ease,
Where unassisted sight no beauty sees.
The shapely limb and lubricated joint,
Within the small dimensions of a point,
Muscle and nerve miraculously spun,
HIS mighty work, who speaks and it is done.

COWPER.

LONDON:

PRINTED FOR R. HUNTER,

Successor to Mr. Johnson,

NO. 72, ST. PAUL'S CHURCHYARD.

MDCCCXIX.

1819

CHARLES WOOD, Printer,
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Biology

TO

Maria

MISS EDGEWORTH,

FROM WHOSE WRITINGS

THE YOUTH

OF THE PRESENT AGE HAVE DERIVED

EQUAL ENTERTAINMENT

AND ADVANTAGE,

THIS LITTLE WORK

IS

RESPECTFULLY DEDICATED,

WITH SENTIMENTS

OF ESTEEM, GRATITUDE, AND AFFECTION,

BY

THE AUTHOR

PREFACE.

The activity of the infant mind requires constant employment. It therefore becomes an important duty, in those who have the care of children, to provide a continual supply of materials; and such as may, at once, gratify and stimulate that spirit of inquiry, which may be guided without difficulty, but which can never be repressed without danger.

Natural History seems to be well suited to this purpose. It is easily kept down to the capacity of any age; and it presents a number of intelligible and striking facts, which amuse the senses, without fatiguing the mind, and which lead to observation, industry, and ar-

rangement. That branch of it, which relates to Insects, possesses these qualities in an eminent degree: the great diversity of tribes, their singular forms, their brilliant colours, the ingenuity with which their habitations are constructed, the variety of stratagems to entice and catch their prey, and, above all, their wonderful transformations, captivate and fix the attention of the young observer. In short, those habits, which constitute the best foundation for the acquirement of valuable knowledge, may be essentially promoted by the early study of Entomology.

Under these impressions the following pages have been written: the general design has been to adapt them to children of eight or ten years old, and so to blend technical language with interesting description, as neither to damp the ardour of the pupil, on the one

hand, nor, on the other, to convey inaccurate information.

There are several popular works on this subject already before the public, but none of them coincide with the above design. Kirby and Spence's *Introduction* is a highly pleasing and satisfactory book, but far beyond the comprehension of the little students for whom this publication is intended. Mrs. Wakefield's *Letters* form a useful compendium, but, perhaps, too dry and cursory for the volatile minds of children. And in Joyce's *Dialogues on the Microscope*, the descriptions are necessarily confined to those examples which suited his purpose.

Such are the considerations which gave rise to this volume, and which encourage a hope, that it may prove, in some degree, a useful addition to the Juvenile Library.

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DIALOGUES

ON

ENTOMOLOGY.

DIALOGUE I.

MOTHS.

LUCY. My dear mamma, are you very busy? If you can spare time, I wish you would come to the garden and explain something which appears very odd.—Oh dear, I have run so fast!

Mother. I am rather busy; but, as I have great pleasure in explaining what you wish to know, I will go with you.

Lucy. Thank you, mamma; I am sure you will not call this one of my foolish interruptions.

Mother. I approve so much of your

disposition to inquire into every thing of which you are ignorant, that I never think such interruptions troublesome. Well, now, here we are in the garden.

Lucy. See here, mamma, at the ivy wall, a strange thing like part of a moth, struggling among bits of leaves and sticks, look, look! it moves, it is growing larger—there are its legs. I really believe it is a moth: now it is entirely come out from among those scraps of dirt. Is it a moth, mamma?

Mother. Yes, it is a moth; but softly; watch how its wings unfold. You see they gradually spread open, with a little quivering motion. Could you have thought so large an animal had been contained in that small case, which you see in the midst of those broken leaves? It is now a perfect moth, and this is the first time it has appeared in that form.

Lucy. How much brighter the colours are than when I first saw its wings! They now look bright and clean, at first they had a wet crumpled look.

Mother. Yes, they were damp; an exceedingly small quantity of moisture surrounds the fly in its case, which preserves the joints in a state of flexibility, that is, suppleness, and enables the wings to unfold to their full size; when they have done so, the moisture is no longer useful, and the air quickly dries it up.

Lucy. But, mamma, if this is the first time of its being a moth, how did it get into that case? how was it put there? My sister told me once, that caterpillars turned into moths and butterflies; do they, mamma?

Mother. Yes; every kind of caterpillar changes into some species of winged insect.

Lucy. Then, I suppose, all kinds of flies, gnats, and bees, have been caterpillars. What tiny little things the caterpillars of flies must be.

Mother. They are very small indeed; so small that many of them are called maggots.

Lucy. Maggots! I always thought maggots were nasty and dirty.

Mother. As several kinds of caterpillars or maggots live in rotten wood, mud, carrion, dunghills, and other substances of which we have the most disagreeable notions, we are too apt to extend the disgusting or nasty idea of the place in which they live to the creature itself.

Lucy. I understand that; but you say that some of these creatures live in mud; now I thought, mamma, that mud was only earth and water.

Mother. Mud is chiefly composed of earth and water; but it also contains many other things, as roots of vegetables and plants, both dead and alive; and also numberless small living creatures, so small, that they cannot be seen without a magnifying glass. Mud contains also a large portion of air.

Lucy. Oh, mamma, you cannot be serious now; air in dirty mud! nice clean bright air in dirty mud! You told me that air is what we all breathe and feel, what is round us, and every thing.

Mother. Certainly we do breathe and

feel the air, and are surrounded by it; but it is not more certain that air is round every thing, than that some portion of it is also contained *in* every thing; and if the air were to be taken out of the mud all the little animals that are in it would die, for no animal can live without air.

Lucy. Yes, for we all breathe the air; but you say animals. I thought animals were large creatures, men, horses, or dogs.

Mother. Men, horses, and dogs, are all animals; but it is not size, it is *life*, which makes them animals; every living thing that moves on the face of the earth is an animal, however small its size may be.

Lucy. Thank you, mamma. I understand every thing you have told me very well. Will you now tell me the history of this pretty moth; and all about the caterpillar; and what was its food; and how it lived; and—

Mother. Softly, softly, my little girl:

you ask as many questions in a breath as would require an hour to answer; and I cannot spare an hour at present: come to me to-morrow after your lessons are finished, and I will answer all your questions about moths and caterpillars.

DIALOGUE II.

CATERPILLAR, PUPA, CHRYSALIS, AURELIA.

LUCY. My lessons are over, and I hope, mamma, you will now tell me about all the caterpillars and moths.

Mother. That would take a very long time indeed, and would besides require more attention and more memory than you are quite aware of. We shall therefore begin with the earliest part of the history of a caterpillar. Do you remember the hairy caterpillar you lately found creeping on the gravel walk?

Lucy. Oh yes; we looked at it in Fanny's microscope; and we saw its tufts of hair, which appeared so large; and its pretty brown and orange skin, that looked so bright between the tufts.

Mother. That caterpillar was once so little, that it was contained in a small round egg, scarcely as large as the head of a pin. From the time it first came out of the egg it increased gradually to its full size, having, in the mean time, changed its skin several times.

Lucy. How did it change its skin?

Mother. As the little animal grows larger the skin becomes too tight to contain it, and at last bursts: the caterpillar then crawls out. In about a fortnight after it has changed its skin for the last time, the caterpillar becomes dull, and ceases to eat; and having passed some days in this state, it then throws off its last skin, and takes a new shape.

Lucy. What sort of shape? what is it like?

Mother. Look into this little box, and you will see that it is smooth and shining, as if varnished over.

Lucy. It does not look in the least like a caterpillar: it is not so long; it is smooth and shining, and round. Of what a dark red brown it is; and how

oddly marked! it is like a very little head, with something wrapped round it.

Mother. From this appearance it has been called *pupa**, which means baby, because it was thought to resemble an infant in swaddling clothes. When it is in this state it neither eats nor moves; though most properly called pupa, it is more commonly termed chrysalis, or aurelia.

Lucy. Why have these names been given to it? What do they mean?

Mother. *Chrysalis* is derived from the Greek word *chrysos*, signifying gold; and *aurelia* comes from *aurum*, a Latin word which has the same meaning; these names were applied from its bright gilt appearance in some of the species.

Lucy. I shall not forget that.

Mother. When the chrysalis, which you found yesterday, had remained in that immoveable state for some months, the moth, which was inclosed in it, by moving its head, burst open one end of

* Pupa, Latin for puppet, or baby.

it, and made its way out, as you had the pleasure of seeing.

Lucy. What delightful things, dear mamma, you tell me; but I want to know a great deal more of the other caterpillars, that I see crawling about. Do they all become moths or flies?

Mother. They all become winged, but there are a great number of winged insects, that are neither flies, butterflies, nor moths.

Lucy. But I want still to know how the moth is squeezed into the chrysalis, and who contrived it so.

Mother. My dear child, no human creature can form even such a little insect as a caterpillar. Do you not remember, I am sure you have been told, who made you, and not only you, but every person, and every thing that is in the world?

Lucy. Yes; God made me and every thing.

Mother. God has power to do what ever he wills; he has made all the living creatures in the world, from the great

elephant and whale, down to the smallest insect. And he does more; he watches over all that he has made: he governs them, preserves them, and provides for all their wants.

Lucy. But, mamma, how then could Mr. E. make the beetle, which Fanny told me she saw run round the table?

Mother. I will ask Mr. E. to lend me that beetle, that you may see the distinction between a machine, to which certain movements only are given, according to the will of the artist, and a living animal, which can act and move according to its own will; and that you may yourself observe, how great a difference there is between the works of man and the works of God.

DIALOGUE III.

EGGS OF INSECTS.

LUCY. Well! mamma, you said you would tell me more about the moths; and I am come to remind you of your promise.

Mother. A promise I shall fulfil with the greatest pleasure; but you must first tell me how much you remember.

Lucy. I have learned that caterpillars come from little eggs; that they grow larger and larger; that as they grow they several times change their skins; that when full grown they change into chrysalises; and that after some time they come out from that form either moths or flies. I believe that is all.

Mother. Very well indeed; we will therefore continue to inquire into the history of the caterpillars; concerning which

there are many entertaining facts to be told. The little egg, which I formerly mentioned, is laid by the parent fly in such a situation, as that the little creature which comes out of it may immediately find the most suitable food; whether that be leaves, or the bark of twigs and trees, or the roots of plants.

Lucy. Then, mamma, they do not all eat leaves?

Mother. No, they do not; their food is of various kinds; but whatever be the kind best suited to them, the fly deposits her eggs either on the plant by which it is furnished, or so near, that the new born animal may immediately reach it. Those, which are to be quickly hatched, are generally placed on leaves.

Lucy. Oh! mamma, yesterday I saw on a large cabbage a great number of caterpillars of different sizes; but most of them were very little things; not so long as this mark on your ruler: I suppose the egg had been put on those cabbage leaves.

Mother. That mark is half an inch. Probably the caterpillars were then three or four days old.

Lucy. And still so little? But to be sure, when they first came out of such very small eggs, they must have been so little that one could hardly see them.

Mother. They were about an eighth part of an inch long; you see they found their proper food ready for them the moment they came out of the egg.

Lucy. Why are those eggs, that are to come out soon, laid upon leaves?

Mother. They are placed on the leaf, because that is the food which they are destined to eat; and, as they are to be immediately hatched, a more concealed place is unnecessary.

Lucy. There are some kinds then that do not so soon come out of the egg?

Mother. Yes, several kinds; and according to the length of time they are to remain in the egg the parent fly chooses a suitable place of security.

Lucy. What sort of place; and how are they kept warm in winter?

Mother. The fly lays the eggs on that kind of tree on which they are to live, either in a cranny of the bark, or in the angle formed by the division of two branches.

Lucy. How are they fastened there, for such light round things would easily roll off?

Mother. They would do so, were it not that, when the fly deposits the eggs, it also drops a sort of glutinous liquid over them, which, being hardened by the air, thus gums them to the bark of the tree.

Lucy. Then all those that are placed on the bark of trees are gummed to the bark?

Mother. No, not all; there are many other methods by which they are preserved. Some species, or kinds, lay their eggs among the close moss, which often grows upon the stems of shrubs near the ground; and under that cover they avoid being seen by their enemies: in other

species the parent makes a warm case for them, by gluing together the down, which she pulls from her breast.

Lucy. Poor thing! what pains it takes to put them in a safe place! I suppose the downy case must keep them quite warm in winter. Are there any other ways in which they are placed?

Mother. Some kinds spin a sort of silk, which they commonly mat together; which silk being formed of a glutinous, or gummy substance, the threads quickly adhere, so as entirely to exclude, or keep out, the air. The moth, as soon as it has deposited its eggs, and provided for their security, dies.

Lucy. What a pity such pretty creatures should die so soon! Do all flies die when they have laid their eggs?

Mother. No; there are insects which live much longer. Some of the butterfly tribe do not lay their eggs in autumn, but at the approach of cold weather creep into holes, in walls or old trees, and remain torpid till spring; at that season

the returning warmth revives them, and then they lay their eggs and die. But all moths lay their eggs in autumn, and die immediately after.

Lucy. Then, mamma, who takes care of the little caterpillars?

Mother. The moth, were it to live, could do but little for them; all that was in its power it had done, by placing the eggs in safety, where the young caterpillars, as soon as they quit the egg, can find the nourishment that is most proper for them.

Lucy. Why could not the moth take some care of the caterpillars, as well as of the eggs?

Mother. Because from its structure, that is, its form or make, it is unable to procure food for them; as the moth lives on honey, which it sucks from flowers; while the caterpillar feeds on leaves, or on the bark of trees. Besides, the moth is as much a prey to birds and other enemies as the caterpillars are.

Lucy. I see that they could not be of

much service to them. So now, mamma, will you tell me how they live till they grow quite large, and what they do?

Mother. Not to-day, my dear; to-morrow you shall have that part of the history of the caterpillar.

DIALOGUE IV.

CATERPILLARS PROVIDED WITH THEIR SEVERAL CHANGES OF SKINS; CONTAIN LIKEWISE THE FUTURE FLY; LARVÆ.

MOTHER. Well, my little Lucy, what is to be the subject of our conversation this morning?

Lucy. Oh! mamma, the caterpillar: because, you know, we finished all about the eggs and the different ways of placing them in safety.

Mother. Very well, we will proceed to the caterpillar; which, at its first coming out of the egg, is——Can you remember about what length?

Lucy. Yes; it is about as long as this little division—let me see; one, two,

three, four, and four more, that makes eight, in one inch, mamma.

Mother. Therefore, as eight are contained in the inch, each division is one eighth part of an inch. The caterpillar is about one eighth of an inch long; but it rapidly increases; and in a few days it throws off its first skin.

Lucy. You told me before, that they change their skins several times; and I have since been thinking how they manage when the old skin is gone and the new one not quite grown.

Mother. They are never in such an uncomfortable state; for at their very birth they are provided with all the skins in which they are afterwards to appear. When the outer skin is, from the growth of the animal, become too tight, the creature seems to lose its appetite, and to be sick; after a day or two, this skin bursts along the back, and the caterpillar, first disengaging its head and legs, then creeps out of its old dress, and appears in its new one.

Lucy. Are the new skins always like the old one?

Mother. Generally they are; but in some species every skin varies from the former one; and this circumstance has given rise to great mistakes, one sort having been sometimes taken for several different kinds.

Lucy. Well, mamma, this is most wonderful; I cannot think how there can be room in such a tiny creature for six skins to lie one within another! How very odd that does seem!

Mother. Yes, my love; such things are indeed wonderful: but all the works of our great Creator are wonderful: and in nothing is his power more displayed than in the structure and perfection of even the most diminutive insect. You feel surprised that all the skins are contrived to fit one within the other; how will your surprise be increased when you hear, that within all these skins the future fly is contained.

Lucy. The moth! Oh! mamma, how

could such a very, very little thing be seen through all the skins?

Mother. It was discovered by a person who made insects of all kinds the subject of his study. With the assistance of a powerful microscope, he saw the little fly placed withinside the caterpillar; its wings twisted like a cord, in a wonderfully small space; its horns coiled, and placed on the head, and the trunk rolled up, and also placed on the head: even the eggs, which, when a perfect creature in its winged state, it is afterwards to lay, are seen already formed, but without colour, and like transparent globules.

Lucy. Mamma, I know that transparent means clear, so that one can see through it: but I do not know what globules mean.

Mother. You are very right to ask the meaning of those words you do not understand, and I can hardly tell you how much pleasure I have in explaining them to you. Globule comes from the word

globe, which means a perfectly round body; a currant is a small globe: a globe a great deal smaller is called a globule.

Lucy. I think that these little eggs must be like excessively small drops of water.

Mother. Yes, they have much that appearance. As the caterpillar increases in growth, the fly also increases, till it comes to its full size.

Lucy. But are all caterpillars like each other; and all of them provided with so many skins, and the fly in the middle?

Mother. In all, the fly is withinside; and they have all of them several skins: though some species may have only three or four, while others have five or six. In shape they vary almost as much as in colour; some being hairy and some smooth; some have horns before and others have them placed behind; some are of great size, while others remain extremely small.

Lucy. I have seen hairy caterpillars and smooth ones, but I never saw one with horns.

Mother. I have drawn in this book the greater part of those kinds which I have met with. What is this one?

Lucy. That is quite smooth; I think I have seen one like it on rose trees; green, with this white line all along the back. And here is the brown hairy one we found on the walk, and brought in. What a number of different sorts are drawn here, and all with their beautiful moths. Do all these, that look so unlike each other, live in the same way?

Mother. Do you not remember, that the parent fly places her eggs in those situations, where suitable food is most easily to be obtained?

Lucy. Yes, indeed, I do remember it. Will you tell me, then, some of their different ways of living?

Mother. Those kinds of moths, which deposit their eggs in cracks and crevices

of the bark of trees, do so because their *larva* feed on the inner bark, and live under the outer bark.

Lucy. *Larva*, what is that?

Mother. *Larva* is the name given to the caterpillar state of all insects, which afterwards undergo a metamorphosis, or change.

Lucy. What does the word mean?

Mother. It is derived from a Latin word signifying mask; the insect having its true appearance concealed, as it were, behind a mask.

Lucy. The larva, then, does not, as I first thought, eat the bark of the tree.

Mother. Trees have a thin green bark within the brown outside bark; on this green bark the caterpillars live; when they are hatched they creep from the crevice in which they were placed under the outer bark, and begin to eat; and as they eat they make a room for themselves to dwell in; so that they live in a

kind of hollow passage, which they have gnawed between the wood and the bark of the tree.

Lucy. They must be quite safe there, for no bird can find them out.

Mother. Not so safe as you think: many smaller creatures take advantage of the labours of the caterpillar, and usurp its hollowed house; and some of these not only feed on the tree, but devour the caterpillar. And even from birds it is not quite secure; both the woodpecker and the creeper run up and down the stems and branches, seeking for grubs; and woe to the unlucky caterpillar that puts out its unwary head when one of these active enemies is near!

Lucy. Do many sorts of caterpillars live in this way under the bark?

Mother. Several of our most beautiful and largest species.

Now, my love, I have promised your sister Fanny to answer her botanical ques-

tions; so we must defer the rest of the caterpillar history till to-morrow.

Lucy. Very well, mamma; you have been very good to stay so long with me. I will now go and weed my nice bed of mignionette.

DIALOGUE V.

LARVÆ, THEIR GENERAL HABITS, AND MODES OF ESCAPE. CATERPILLAR OF THE OAK.

LUCY. I hope, mamma, you have leisure to tell me a great deal about caterpillars, to-day. I have been reflecting on what you told me yesterday, and it is so entertaining that it makes me quite anxious to hear more.

Mother. I am glad to be able to amuse and instruct you at the same time. We ended with the species that live under the bark of trees. Other kinds live in rotten wood.

Lucy. What can they find there to nourish them?

Mother. It has not, I believe, been

ascertained whether they actually eat the rotten wood, or prey upon the lesser animals, which have made their nests in the same place of concealment: however this may be, the larvæ of some of our handsomest moths, and those of several kinds of flies, live in rotten wood.

Lucy. Then, mamma, larva does not mean the caterpillars of moths alone.

Mother. The name of *larva* is given to all insects during the first stage of their life, whatever may be their future shape: that of *caterpillar* has been applied chiefly to the larvæ of the moth and butterfly tribes. Some caterpillars feed on the juicy roots and stalks of dandelion, and of other plants of that kind; but these usually eat at night, or late in the evening, and are therefore very difficult to find, as they conceal themselves during the day in shady places, or retire into the ground.

Lucy. Into the ground! How can such hairy creatures force themselves into the earth?

Mother. None of the hairy kinds go into the ground: those which burrow are smooth; and as the ground is always rendered less hard or compact by the slender fibrous roots of plants, they can readily make their way into it.

Several species of caterpillars have so much the appearance of the substances on which they feed, that it is difficult to distinguish them.

Lucy. But how can they look like leaves?

Mother. It is not in shape but in colour that the resemblance to leaves consists, having sometimes their exact shade of green or of brown; other kinds are so like the small branches upon which they are found, that you might easily mistake them for the short twigs. Some of them are quite smooth, like the twigs of the plane tree; and some are marked lengthways with dark streaks, resembling the shoots of the elm. Thus, you see, many must avoid being discovered by their pursuers. But some spe-

cies have a still better mode of escape, for they spin a slender thread whenever they move, and when pursued they can throw themselves from the leaf, and hang by this thread.

Lucy. Indeed, mamma, I have observed caterpillars hanging just so between the bough of a tree and the ground, by a thread that I could hardly see.

Mother. But perhaps you did not observe, that, when the caterpillar climbs up again by the thread, as it cannot help spinning while it moves, the thread is doubled by the time it has reached the leaf or spray from which it threw itself; it then nips the thread asunder with its jaws, which are very sharp, that it may not have an additional weight of thread to drag.

Lucy. I am determined to watch for these hanging caterpillars. Do not you think that under the large oak in the lawn, or perhaps at the lime tree with the seat under it, I might see them?

Mother. Very probably you may find them on either of your favourite trees, as both oak and lime are inhabited by several different species. There is one very remarkable kind on the oak, which is often met with in France, but has not yet been discovered in England.

Lucy. Dear mamma, do pray describe it to me.

Mother. It is hairy, of a middling size, and a dark red brown colour; the generality of caterpillars live singly, but of this species, large numbers, perhaps three or four hundred, assemble together.

Lucy. Three or four hundred! what an amazing number. How very curious a sight that must be!

Mother. They are very industrious and very friendly, giving their mutual labour for the benefit of the community; they spin in concert a sort of roof or covering of brown silk, the edge of which they fasten to the stem of the tree, leaving little openings, or doorways, for creeping

in and out. Under this silken roof they remain all day, coming out in the evening only to seek their food; and as they live together so they move together.

Lucy. What! three hundred walk about together! why they must cover a monstrous space.

Mother. Not quite so monstrous as you think, for they do not wander about, but march close together in ranks, like soldiers, and in a sort of wedge-like order. One acts the part of chief, and, leading the way, is closely followed by two; those two are followed by three, and so on, each of the rows increasing one in number: if the form of the ground, however, does not answer for their usual order of march they have been known to alter it.

Lucy. How delightful it would be to meet these caterpillar soldiers marching away! But such a number must soon eat up all the leaves on a tree.

Mother. When that is the case they march off by night to another tree, and,

spinning a new tent, establish themselves upon its trunk. They at length change to chrysalids, and remain in security till they come forth as moths.

Lucy. Are there any other kinds, that live so comfortably together?

Mother. Yes, there are; we have one which is very common in England. It is small, of a dark colour, and produces a little grey moth; it lives in great numbers upon the *euonymous tree,* surrounded by a sort of web, spun with strong threads from branch to branch. At a little distance the tree looks as if it were covered with cobwebs.—

DIALOGUE VI.

SOCIETIES OF CATERPILLARS. CATERPILLAR OF CLOTH, OF PONDWEED. ERUCÆ. TRACHEA, STIGMATA. CLASSES.

LUCY. Dear mamma, I was so sorry, that those troublesome visitors interrupted us yesterday, in the middle of that charming history of the spinning caterpillars.

Mother. Those visitors were very good and respectable people; and, although they interrupted you, they do not deserve to be called troublesome. We must learn to bear with many interruptions through life, and still more with such very trifling disappointments as that.

We will now return to the caterpillars: I think we were speaking of those which live in societies on the euonymous.

Lucy. Yes, mamma; and I want to know whether many other kinds live in companies like those.

Mother. There are several species which do so; some live separately till nearly half grown, and then unite in societies; others associate for a time, and when grown strong enough they separate, and seek their food alone.

Lucy. I suppose that many sorts always live by themselves: how do they manage?

Mother. They live most commonly on leaves, on the under side of which they feed, that birds may not see them. Some kinds even curl one edge of the leaf, and attach it to the other part by threads of gluey silk: thus making a hollow case fitted to its own shape, and open at each end. On privet, and on young laurel leaves, you may frequently find these rolled up dwellings.

Lucy. I will look this very day on the privet hedge, in hopes of seeing them.

Mother. These rolled leaves are often found on pear and apple trees, which, some years, are materially injured by the numbers of their little guests. There are two or three very small species, which eat cloth and fur; they spin round themselves a case a little wider than their bodies, so that they can just turn round; in these cases they live, and, putting out their head and legs, carry their house about with them.

Lucy. Just like snails, I suppose; how very odd the little thing must look, dragging its long narrow house after it. I wonder what nourishment it can find in cloth.

Mother. There is hardly any substance which does not afford food for some description of animal. You may observe another curious circumstance of these *cloth* caterpillars; the colour of what they spin, to enlarge their case, is determined always by that of the cloth on which they feed; and by changing the

cloth, you can make them stripe their houses with various colours.

Lucy. I must look for some of these little animals, and, if you will give me some bits of blue and red cloth, they shall spin their cases of those colours.

Mother. Most willingly you shall have some pieces of cloth, though I hope you will not be able to find any of these destructive creatures. Cloth eaten by them is vulgarly called moth-eaten, and their cases moth-bags; but, in fact, the moth is hurtful only because it lays the eggs from which the caterpillars are produced. One of the most curious species of caterpillars, in their habits of life, is to be found on ponds.

Lucy. On ponds! In water! How is that possible? How could they breathe?

Mother. I did not say *in* water, but *on* it; that is, on a plant called *pondweed,* which grows in stagnant pools. When this diminutive animal quits the

egg, it cuts out a piece of leaf, and by means of its silken spinning fastens this bit round the edges to another part of the same leaf, leaving a few openings by which to creep out and feed. When it grows too large for this first habitation, it cuts out another circle of the leaf, and makes a second suitable to its size; as it increases, it thus constructs new dwellings, till it changes to a pupa, which, from its lightness, floats upon the surface of the water.

Lucy. As long as it remains a little chrysalis it may swim; but the poor fly, what saves it from the water?

Mother. When the fly bursts its narrow cell, it creeps out, and, resting upon the empty chrysalis, as it were upon a boat, remains there till strong enough for flight, when it becomes an inhabitant of the air.

Lucy. How beautiful to see it spring from its light boat and fly away! What a number of different kinds you have already described; and I dare say there are

many others which you have not yet mentioned.

Mother. A great many, indeed; too many to give you an account of them all. But that you may clearly distinguish those about which we have conversed from a sort of erucæ called false caterpillars, I will define the true caterpillar.

Lucy. Erucæ; you never mentioned them before.

Mother. *Erucæ** is a general name for all maggots, worms, and caterpillars, that are the larvæ of more perfect winged insects. You remember what larva means?

Lucy. Oh yes, the young of every kind of insect; and it means mask, and it is a Latin word.

Mother. Quite right: we will go on then. All *caterpillars* are much longer than they are broad: they have twelve rings in their bodies: the covering of the head is of a shelly hardness, but the rest of

* *Eruca,* Latin for a canker worm.

the body is soft; some species have only six feet placed on the rings next the head, and two formed of a hollow membrane, which are placed on the last ring.

Lucy. What is the meaning of membrane, mamma?

Mother. It is a sort of skinny substance, which is so elastic as to have the power of contracting or closing up, and of expanding or stretching out. These two membranous feet slope backwards; they are hollow, and the part on which they walk is formed of a shelly ring, and fringed with very short hair. Those caterpillars, for instance, which I told you resembled little twigs, have no more feet than these, that is, six horny feet for walking with, and two membranous feet on the last ring; but the greater number have eight more feet, all of the membranous kind, and placed four on each side. Through these ten membranous feet the caterpillar breathes; and they are called *trachea,* a Greek word, which signifies a windpipe.

Lucy. Then they both breathe and walk on these feet. Why are they called windpipes?

Mother. Because they answer the purpose of respiration, or breathing, as your windpipe does, and they are formed in the same manner.

Lucy. Then, mamma, I suppose these breathing feet would be spoiled by dirt, only for the little hairs that grow round the edges.

Mother. I give you credit, my love, for exerting your reason; you are probably quite right in this case. There are also other passages through which they breathe, and which are connected with the *trachea;* these openings are called *stigmatæ**, and are generally marked by a bright spot, which sometimes looks like gold.

Lucy. I see them quite golden and bright in this dark, hairy caterpillar, which I have in my box. Let me see; yes, there are nine on each side.

* From *stigma,* a mark or band.

Mother. There is usually that number, but I believe it varies in some species. When you find any caterpillars which have more than *sixteen* feet, you may be certain that they are the erucæ of flies.

Lucy. That is, you mean both the hard feet for crawling, and the soft feet reckoned together.

Mother. Exactly. Caterpillars have been divided into classes by some naturalists, according to their habits of life, or to their appearance. Here is a list I have written for you, that you may look over and remember them.

The *gregarious*, or those that live in societies.

The *solitary*, that live singly.

The *smooth.*

Those which are *hairy* all over.

Those with the hair divided into little *brushes.*

Hairy, but with longer *brushes at the head and tail.*

The brushes forming a *tuft, or aigrette,* on the head.

Those with *spines.*

Those like *shagreen.*

But as the divisions must depend more upon the perfect fly than on the imperfect larva, this classification cannot be of very great use.

Now, my dear, go out and divert yourself; and to-morrow, if nothing *interrupts* us, we shall see how the caterpillar changes to the pupa.

DIALOGUE VII.

TRANSFORMATION OF THE CATERPILLAR TO THE PUPA. NYMPHS. DURATION OF THE PUPA. PLACE OF CONCEALMENT.

LUCY. How fortunate I am, mamma, that nothing has happened to prevent your going on with the account of the pupa, as you promised.

Mother. As I shall not be able to stay long with you to-day, we will begin at once. When the caterpillar has lived its destined length of time, it ceases to eat; and, creeping to a place of shelter and security, it becomes dull, seems to dislike moving, and after passing some days in this sluggish state, it works out of the old skin, which opens along the back.

Lucy. I suppose, just as when they changed their skins, and crept out in their new clothing.

Mother. The skin bursts open just in the same way; but the animal's appearance is very different: its shining case now fits it quite closely; it has neither eyes nor legs; but on examination you may see indistinct marks, as if the parts underneath had pressed out the case while it was soft.

Lucy. Here is the chrysalis, which you shewed me the other day: it has indeed marks at each side, as if the wings were just underneath; and here, at this round end, and quite close to those marks, seems to be the head; the body I suppose fits into this narrower part, which is marked with rings.

Mother. When the pupa first comes out of the caterpillar skin, it is moist, and quite soft: in this state it is very easily killed, and seems to suffer from the slightest touch. Some kinds remain in this soft state for three days; others

harden in a few hours; but during whatever time they continue soft, they are called *nymphs*.

Lucy. Why nymphs?

Mother. That name is given to distinguish a recent pupa, which has not completed its change, from a perfect pupa. In ancient times, all nymphs, or young women, wore veils, through which they were indistinctly seen; from whence this name of nymph came to be applied to the pupa while in this state.

Lucy. Pray, mamma, why cannot you see the fly inside of *this* case?

Mother. Because it is a perfect pupa, and the covering has become thick; but in the nymph state, the outer skin or case is so transparent, that, with the assistance of a microscope, the fly can be very plainly distinguished.

Lucy. And have they still their horns and their trunks, rolled up and placed on their heads?

Mother. No; the *antennæ* or horns are now stretched along the sides; the

trunk is rolled up into a little case, which is in the front of the face; and the wings, instead of being twisted, are curiously folded up; so that, although of their full size, they occupy an astonishingly small space. The diminutive eggs, which, you may remember, I described as clear and colourless, are now become of their full size, and of the colour which they are to have when laid.

Lucy. Then all eggs are not white?

Mother. Some are yellowish, some of a pale greenish hue, and others pale blue.

Lucy. And, mamma, how long have the moths been of the full size.

Mother. It is difficult to be certain on this point; but from some experiments it has been inferred, that by the time the caterpillar has completed its growth, the fly has also reached its full size.

Lucy. Then why need it remain so long in the pupa? It might as well come out of the caterpillar, and fly at once.

Mother. Certainly, if Providence had

so formed it; but, though in size and shape it is perfect, it probably requires time for its limbs to become sufficiently firm and strong to enable it to run or fly; for, the nymph, you know, is soft, and so is the fly withinside of it.

Lucy. About how long is it necessary for them to remain in the pupa state?

Mother. Different species require different lengths of time, but the greater number of moths continue in the torpid state about eight months; they usually undergo their last change in Autumn, and come out in the perfect state about May or June. Some few species remain in the chrysalis for a whole year.

Lucy. Is it not very wonderful how they continue to live without food for such a length of time?

Mother. If they moved about it would be very wonderful; but as they never stir they are never exhausted, and therefore do not want food to restore their strength.

Though moths remain so long a time

inclosed, butterflies generally appear in eight days after they have changed.

Lucy. But, mamma, I thought moths and butterflies were the same thing; that is, the same kind of insect.

Mother. In several respects they resemble each other; but in others they are very different. Butterflies delight in sunshine, and fly only during the day, fluttering over the flowers from which they sip the honey. Moths, on the contrary, take wing after sunset, and fly till sunrise, when, like the owl, they retire into the shade, and rest during the day.

Lucy. Are the pupas of all butterflies and moths like this brown one in the box?

Mother. No, they are of many different shapes, and of various colours. Those of butterflies are all more or less *angular*, like this, which you see, drawn here. (Plate I.)

Lucy. Oh! that is the dear little house butterfly: what a pretty chrysalis

it has! and I do see a little gold upon it!

Mother. Several of the butterfly pupæ have some gold; but I have never seen any moth pupæ that had. There is some variety in the points and protuberances of the different butterfly pupæ, but they have all a general resemblance in shape, though not in colour, to this one.

Lucy. Where are these chrysalids to be found? I think they must run great hazard of being destroyed.

Mother. When the caterpillar is about to change, it creeps up a wall or a tree; and, having spun a small mat, on which it fixes its hind feet, it then begins to spin a band across its body. This it effects by twisting its head backwards and forwards, fastening threads to the wall, first at one side, and then at the other, which are all carried across its body, till the band is strong enough to support its weight. After having rested for a day or two it then changes, and the skin falls to the ground; but at the tail

end of the pupa are two small hooks, which lay hold of the little mat, as soon as the old skin drops.

Lucy. And it hangs there a chrysalis! How nice! But was this brown one hung in that manner?

Mother. No, it was not: there are many that do not suspend themselves in that way, but we must defer their description till to-morrow.

DIALOGUE VIII.

VARIOUS MODES OF FORMING, SECURING, AND QUITTING THE PUPA CASE. EMPEROR MOTH.

LUCY. We stopped yesterday at the account of the caterpillar, that suspends its pupa by the tail.

Mother. There is another species, which spins only the band across the body, without the little mat for the tail to hook. Not having the power of turning its head as far as the caterpillar does that I mentioned yesterday, it cannot pass the thread over its back; it therefore fastens the end on one side, then carries the thread across the fore feet, which it holds up for that purpose, and firmly attaches it to the other side; repeating the operation till the band is sufficiently strong. The threads how-

ever are not glued together, but resemble a little hank of silk; and when completed the caterpillar can just slide its head and body underneath as far as the fifth ring. This species feeds on fennel.

Lucy. But if the band should be too tight, poor thing, what happens then, after all its labour?

Mother. If too tight, the caterpillar cannot get underneath, and if too wide, it falls through; in either case, it never completes its change, but dies in the caterpillar state, not being provided with silk enough to make a second band. Some kinds make only a little mat, in which they fasten their tails; suspending it from the small twigs on the stems of trees.

Lucy. But this brown one in the box does not seem to have been hung from any thing?

Mother. There are many species, which do not spin at all; of these, some retire into crevices in walls or trees, but the greater number creep un-

derground, and work out a sort of cell, where their metaphorphosis is effected.

Again, those kinds which spin, have different ways of doing it.

Lucy. Do you mean like the wonderful oak caterpillars, that spin their brown tents to live in by hundreds?

Mother. They, you know, spin those tents to live in while they remain caterpillars; but I allude to certain species that spin round themselves the case in which they are to make their change.

Lucy. That is like the silk worms, of which I have heard Fanny speak.

Mother. Yes, and no other kind has yet been found worth the trouble of cultivating, for the sake of the materials of which those cases are composed, though a very large proportion of the caterpillars of both moths and sphinges have the same habits. Their cases vary in form and colour, and indeed in the disposition and texture of the silk; some are oval, rough, and of a pale brown or yellow colour; while others are egg shaped, full at one

end, and narrow at the other. The caterpillar of the *emperor moth* makes its case somewhat in the last shape, as you may perceive from this empty one, which I have preserved since last year: and here are drawings* of the moth it produced, and of the caterpillar and pupa.

Lucy. Oh, what a pretty caterpillar! How very beautiful the moth is; and this, I see, is the outer case! What a curious shape. It looks as if it had been gummed over! But how could the caterpillar gum the outside of the case, after it had spun itself up withinside?

Mother. The outside was first formed with thinly woven silk, glued together by a shining substance; and within, there is a thick web of silk, crossed in every direction; now, observe the narrow end, do you see that it is jagged?

Lucy. Yes, and below this jagged edge is another row of jags, and underneath that another and another.

* Plates II and III.

Phalæna Pavonia
the
Emperor Moth.

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Mother. Very well: now examine and tell me if these jags simply project from the sides, or if they are disposed in any particular manner.

Lucy. They do not stand straight out from the sides; I see that they slope upwards, so as nearly to meet in the middle; indeed the two upper rows do meet.

Mother. Can you find any good reason for their being so arranged? Think a little, and then tell me.

Lucy. I do think, mamma, that I have found it out. They are placed so to prevent other creatures from getting in to disturb the pupa, for these stiff jags would run into and hurt them.

Mother. Very right; and you may observe, from the direction in which they are sloped, that the moth can easily press them back, when it creeps out.

Lucy. That is, indeed, a wonderful contrivance; but how do those, that have not this sort of door, get out of their thick cases?

Mother. There is a nice contrivance for

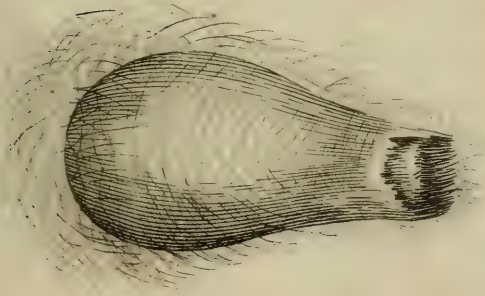
their assistance also: the end of the *cocoon* (the common name for these silken cases), which is next the head, is the last part that is spun, and very thin; resembling in some measure a cap or lid. Immediately under the moth's head there is placed a very small bag, filled with a liquid of such a powerful acid, as instantly to dissolve the gum by which the silky fibres are cemented; and when this is softened the fly can easily make its way out.

Lucy. But it must first have got out of the chrysalis shell, before it can get through this outside case; how does it manage that?

Mother. Over that part of the moth's back, which is next to the head, you may observe, in the chrysalis, a straight line; it is more strongly marked in some than in others, but it is always along this line that the shell opens; the opening is made by the moth's moving its head up and down, which enlarges the slit sufficiently to let the fly out.

Very large cases however are made

Caterpillar
of the
Emperor Moth.



Outer case, which protects the Pupa.

Pupa.

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by some kinds of larva, although they do not spin.

Lucy. How do they contrive that, if they cannot spin?

Mother. The caterpillars, that do so, make a sort of matted web, of their own hair, and of the glutinous matter with which they are generally provided. Others form their cases by gluing pieces of leaves together. And those, which live in wood, gnaw that substance with their jaws into small particles, almost as fine as dust, and working these together with their own gum, form a strong case, so closely resembling the wood to which it is attached as to be with great difficulty distinguished.

Lucy. What a number of different ways there are of making these surprising little cases!

Mother. At present, I will mention but one more; some of those, who fold back the leaf to make their little mansion, when about to change, fill up the

ends, which had before been open, with a close web of whitish silk.

The chrysalis, which you found, was covered with a case made of very small scraps of leaves.

Lucy. Oh, yes, I remember it was; but, mamma, you would not let me touch the moth; you said I should spoil it.

Mother. And so you would; for, if the fly is at all disturbed while its wings are expanding, it is never able to complete the work—its wings remain misshapen and useless—the poor creature is incapable of flying—and, from the weight of its body, seems even to crawl with difficulty.

Lucy. Did you not tell me, when I found that chrysalis, that the little moth was damp while in its case?

Mother. Yes, there is just enough of moisture to keep all the parts soft, and the joints supple; without this moisture the delicate wings would become stiff, and would not have the power of ex-

panding; but in half an hour from the time of its coming out, the wings have stretched to their full size, and the moisture being no longer useful is, by that time, dried up. Now, my dear, we must break off our conversation for this morning; to-morrow I will explain the differences of the *moth*, the *butterfly*, and the *sphinx*.

DIALOGUE IX.

MOTH, BUTTERFLY, SPHINX. DIFFERENCE OF THEIR ANTENNÆ. LEPIDOPTERA.

LUCY. Yesterday, mamma, you said you would tell me the difference between moths and butterflies, and some other fly with an odd name.

Mother. The odd name that you forget is *sphinx;* this insect differs in some particulars from either the *butterfly* or the *moth;* for instance, it flies only at sunrise and sunset.

Lucy. But why has it such a strange name as sphinx?

Mother. In the Grecian fabulous history, we find a monster described, of that name, whose body and limbs resembled

those of a lion, though, in its head and neck, it was shaped like a woman. It was always represented in a prostrate position, with the fore paws extended forwards, but holding its head erect; just as you often see our large dog Basto lie at the hall door.

Lucy. I understand; but I should like to see a drawing of it.

Mother. If you remember to ask papa this evening he will show you, in Denon's Travels in Egypt, the engraving of the celebrated statue of a sphinx.

Lucy. I will, mamma; but why is a little gentle moth called a sphinx?

Mother. That fanciful name has been given them, because the caterpillars of some of this genus are often found in a posture resembling that of a sphinx.

Lucy. Is this kind as common as the others, which you have mentioned?

Mother. No, it is not so frequently met with in England; and besides, there are much fewer species of sphinges than of moths or butterflies.

Lucy. You said, that moths fly after sunset, butterflies in the day-time, and the sphinx only at sunrise and sunset; is there no other difference? If they were all to fly about in the day-time, how could I distinguish them?

Mother. Their general appearance, as well as their modes of flying, are very different; and, on close examination, you will find, that their *antennæ* also vary.

Lucy. I think, you said, antennæ were horns?

Mother. Yes; they are somewhat like horns, and they are also called *feelers*, because insects seem to be very careful in feeling their way with them. Here are drawings of three kinds of antennæ: this one

is called *clavated**, or club shaped; and all butterflies invariably have antennæ of this form.

* From *Clava*, a club.

Lucy. It is, indeed, something like a stick with a knob at the end; I think, it might answer as a club for the little fairies, who are said to make their cloaks of the butterflies' wings.

Mother. It would suit them admirably. This one

you see is of another shape.

Lucy. It is quite different: very fine at both ends and thick in the middle.

Mother. That is always the case in the antennæ of the sphinx; it is called *fusiform**, and is, I believe, peculiar to that tribe. Now look at the antennæ of the moth,

which you see are thicker next to the head, and taper gradually to the point.

Lucy. Has this kind of antenna any name?

* From *Fusus*, a distaff or spindle.

Mother. Yes, it is called *setaceous* *, or bristle shaped.

Lucy. But here is a fourth shape, like a feather,

with the fringe on the sides, and a rib in the middle.

Mother. Describe the shape of that rib.

Lucy. It is thicker next to the head, and lessens towards the point. How is this kind of antenna called?

Mother. *Pectinated* †, or *comb shaped;* but more commonly *feathered.* Moths have both feathered and unfeathered antennæ, but they are always taper.

Lucy. The distinction is very plain: I am sure I shall not forget it. Have all the different kinds such long antennæ as are drawn here?

Mother That depends upon the size of the fly; but, in proportion to that size,

* From *Seta,* a bristle.

† From *Pecten,* a comb.

the length is generally as great: however, in the *phalænæ*, or moth genus, there are a few species whose antennæ are very short.

Lucy. Why do you say *phalænæ*, mamma?

Mother. Because moth is only the English name: but *phalæna* is the scientific term, derived from the Greek, and therefore known by well informed people in all parts of the world, whatever appellation it may bear in the language of any particular country. In the same way, the butterfly is called by the Latin name *papilio.*

Lucy. And for the same reason, I suppose, you said pectinated instead of comb shaped, or feathered, which seemed to me so much plainer; and instead of bristle shaped you would use the word setaceous.

Mother Very well indeed! I am glad to see that you remember the names so correctly. What are the antennæ of the papilio called?

Lucy. Oh! I recollect perfectly, both that papilio is butterfly, and that its antennæ are clavated, or club-shaped.

Mother. We have now gone through the order *lepidoptera*, the third order of insects.

Lucy. Lepidoptera! What does that mean, mamma?

Mother. That name is composed of two Greek words, one of which* signifies a scale, and the other† a wing; because the wings, of every species in this order, are covered with small scales. To the naked eye, these scales look like meal; but, when highly magnified in a microscope, they are found to resemble little feather-like scales‡. Now, my love, remember all these scientific terms; and come to me to-morrow at the usual hour.

* *Lepis.* † *Pteron.*

‡ See Plate 18.

DIALOGUE X.

ORDERS OF INSECTS; SILK WORMS; MISCHIEFS PRODUCED BY INSECTS; TORTOISE SHELL BUTTERFLY; ELEPHANT HAWK MOTH.

MOTHER. Well, Lucy, can you tell me the meaning of the term lepidoptera?

Lucy. It is made out of two Greek words, that mean scale and wing, because the wings are covered with little feather-like scales.

Mother. That is precisely what I told you: and insects, of this order, have always four wings.

Lucy. But, mamma, are there no other flies that have scales on their wings?

Mother. No other; it is therefore

the most distinguishing character, which the order could have.

Lucy. Why do you say order?

Mother. For the sake of precision, and to aid the memory, all animated beings have been arranged, by naturalists, into *classes*, such as quadrupeds, birds, fishes, insects, &c. Each of these classes, or large divisions, is again divided into *orders.* The class of insects contains several orders; of which the lepidoptera is the third. As we have gone through this order, shall we now proceed to another?

Lucy. Mamma, before we go farther, I should like very much to learn something more of these pretty creatures, which you have drawn so nicely; and I should be very glad also to know whether the butterflies and moths of other countries are like ours?

Mother. Many of them are exactly of the same species as those that we have; but abroad there is a greater variety, and many are much larger, and more beauti-

fully coloured than any that are found in this country. In South America, for instance, there are some which measure five or six inches across, when the wings are extended.

Lucy. What fine large caterpillars they must have!

Mother. I will show you some books, which contain engravings of a great number: and you may recollect, that from some foreign species we derive a most ornamental and beautiful substance.

Lucy. Oh, mamma, I am sure I can guess what that is, because you know I have heard something of the *silk worms.*

Mother. You have guessed rightly. China produces several distinct species, that supply silk of different qualities; but in Europe we have only one kind, of which the food is the white mulberry leaf. The cultivation of silk worms is quite a trade, by which thousands of people gain a livelihood.

Lucy. People who weave silk?

Mother. No, no; I speak of those,

who attend the worms, which, as soon as they are hatched from the eggs of the moth, are kept in warm rooms, and supplied with fresh leaves every day; it is necessary to preserve great cleanliness; all withered leaves are carefully removed, and fresh air is occasionally admitted. In a few weeks the caterpillar arrives at its full growth, and immediately proceeds to spin; winding the glossy yellow silk round itself, till in seven or eight days it is encompassed by an oval ball, or cocoon, the size of a pigeon's egg.

Lucy. But how can the silk be taken off these cocoons? It must break every minute.

Mother. It is stronger than you think, and easily wound upon reels, by those who are accustomed to the work.

When the cocoons are completely formed, the first operation is to pack them in shallow baskets, and bake them in the oven.

Lucy. So they kill all the poor moths.

Mother. Not all; some of the finest cocoons are preserved to produce young worms for the next year. The baking requires much exactness, that the cocoons may not be scorched, and yet that the fly may be killed. They are then thrown into a copper basin, in which the water is kept to a particular heat; and the threads of three or more of them, according to the size of the silk that is wanted, are wound together upon small steel reels. In this state it is called raw silk, and is sold in hanks to the manufacturers.

Lucy. Are there many other insects that are of use to us?

Mother. A great many; but not among the lepidoptera.

Lucy. Well, there are none of these however that do us any harm.

Mother. There you are much mistaken; the caterpillars of several species do a vast deal of mischief, by devouring the leaves of cabbages, lettuces, and numbers of other useful or beautiful

plants. The West Indian planters are great sufferers from the caterpillars of a small moth, which feed upon the cotton shrub. This species is so remarkably short a time in coming to its perfect fly state, as to have several successions during the summer; and as each female moth lays four or five hundred eggs, you may imagine how great the increase must be.

Lucy. Is there no method of getting rid of these hungry swarms?

Mother. Many ways have been tried, and with various success; but I believe their most effectual destroyer is a small wren, which feeds on them. There is a curious circumstance respecting this caterpillar, that, while it is eating, a fragrant odour is diffused through the air, although neither the creature nor the cotton plant have, separately, any smell.

Lucy. That is very surprising indeed; but perhaps, mamma, the sweet smell is to attract the wren, and point out where they are.

Mother. That is very possible; and, my dear little girl, it gives me great pleasure to find, that you can reflect, and that you do not learn merely like a parrot.

To-morrow we may proceed a step farther, as I think you are now sufficiently versed in this order of insects to enable you to read more detailed accounts with both amusement and benefit.

Lucy. Before you go, mamma, will you tell me why the tortoise-shell butterfly, in this drawing*, is called papilio urticæ?

Mother. Because *urtica* signifies a nettle, and its caterpillar feeds upon that plant. You see it represented there in all its stages of existence; first, as a caterpillar, which, you will observe, is one of the spinous sorts; then, in the intermediate state of pupa, or aurelia, as we may fairly

* Plate I.

call this kind, from its golden spots; and lastly, as the perfect fly, or, as that is scientifically termed, the *imago* state.

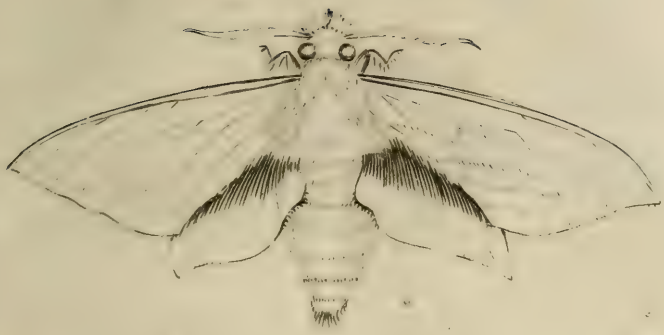
Lucy. How pleasant it is to see all its different forms at one view. The next drawing*, mamma, shows the different states of one of the sphinges.

Mother. Yes; the *sphinx elpenor,* or *elephant hawk moth.* Perhaps you might find its caterpillars in the months of June and July, if you look in marshy places. They sometimes eat vine, and convolvolus leaves; but they prefer white ladies bed straw to any other plant.

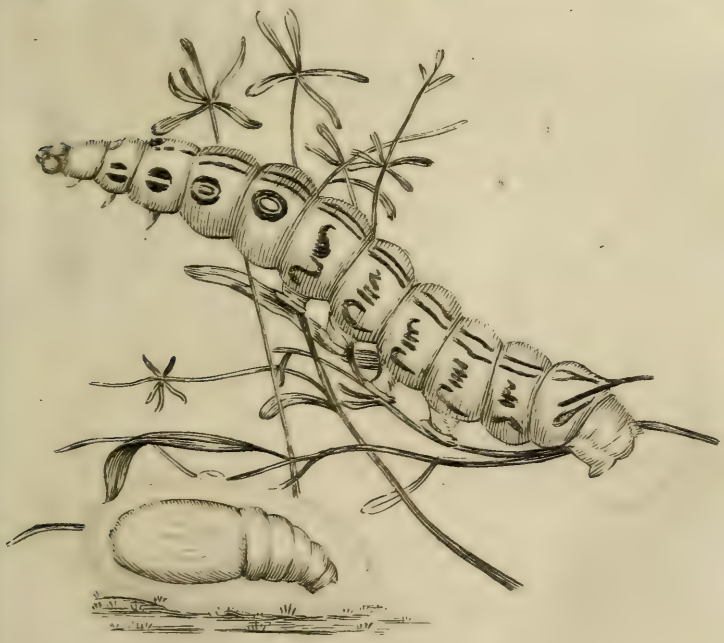
This caterpillar has a peculiar power of protruding, or pushing forward, its head and the three first joints of its body, so that it appears tapering to a point; it can also draw in its head, so as to be entirely concealed.

Lucy. I will certainly search for

* Plate IV.



Sphinx Elpenor. Elephant Hawk. Moth.



The Caterpillar and Pupa.

Published November 1, 1818, by R. Hunter, St. Paul's Church Yard, London.

some of these curious caterpillars. To what a nice smooth sort of pupa they appear to change!

Mother. Yes; the pupa is smooth, with a white web spun round it; in this state it remains all the winter, and the fly comes forth about June.

DIALOGUE XI.

NATURAL HISTORY DIVIDED INTO KINGDOMS. EACH KINGDOM DIVIDED INTO CLASSES, AND SUBDIVIDED INTO ORDERS, GENERA, AND SPECIES.

Lucy. Mamma, you said yesterday, that all animals are arranged in classes; will you explain this to me?

Mother. With pleasure, my love. All nature has been divided, by scientific men, into what they call *kingdoms;* thus—the *animal* kingdom; the *vegetable* kingdom; and the *mineral* or *fossil* kingdom. Each of these kingdoms is arranged in distinct classes, which prevents much confusion, and affords great assistance to the learner. The vegetable and mineral kingdoms, with their classes and subdivisions, you will have great pleasure in learning hereafter, when you

are tolerably well acquainted with the animal world.

Lucy. It is then the animal kingdom that I am now learning.

Mother. One class of that kingdom is the subject of our present conversations; and hereafter I hope we shall acquire some knowledge of the other classes.

Lucy. How many classes are there in the animal kingdom?

Mother. The first includes all animals that suckle their young; a characteristic which extends from mankind down to the little bat, that you so often watch flitting about in the evening: this class is called *mammalia,* from the latin word *mamma,* a teat.

Lucy. I think I shall remember that; it is so odd, that men and bats, elephants and mice, should be all in the same class.

Mother. You see they are all possessed of one property, which distin-

guishes them from the rest of the animal world.

The second class consists of *avès*, or birds; and includes every feathered creature, from the tall ostrich to the tiny humming bird.

Lucy. The pretty little humming bird, that hovers over flowers, and sucks the honey.—And the third class, mamma?

Mother. Is the *amphibia*, or those creatures which possess the power of living, with equal facility, on the land or in the water, although they chiefly inhabit the former. For instance, serpents, lizards, and frogs, are *amphibious;* this term being compounded of two Greek words*, which signify the capability of existing in either element, air or water.

Lucy. I have often heard of amphibious animals, but I did not before know what that expression meant.

Mother. The fourth class is *pisces*, or

* *Amphi*, both; *Bios*, life.

fishes. The fifth, *insecta*, or insects. The sixth and last class, *vermes*, contains a great variety of animals, which, in comparison with those of the other classes, seem to be the least perfect of the animal creation; they have no distinct head, few have any feet, and they appear to want the organs of hearing and sight; earth-worms, oysters, &c., belong to this class.

Each of these classes is again divided into *orders;* but at present, I think, we had better attend to the orders of that class only which we are learning;—to what class do I allude?

Lucy. The insecta, or insects; the fifth class of the animal kingdom.

Mother. Very well, Lucy.

Lucy. But what does *insect* mean?

Mother. It comes from *inseco*, a Latin word, signifying *to cut into*, because the bodies of insects are almost separated into two or more parts or rings, though connected together by a slender membrane. In the same way the term

entomology, or the science which treats of this class of animals, is derived from the Greek word *entoma*, which has the same meaning as *inseco*. The class of insects is divided into seven *orders*, each of these orders is subdivided into *genera*, and the genera are still farther divided into *species*.

Lucy. I am afraid I shall not remember all this.

Mother. At first it may seem difficult; but attention, and the habit of using these terms, will not only enable you to remember them, but will also show you their utility.

We have already gone through one order, can you recollect what it is called?

Lucy. Lepidoptera; and I believe you said it was the third order.

Mother. Yes; this order contains only three genera; the butterfly, the sphinx, and the moth; tell me their scientific, or technical, names.

Lucy. The butterfly is papilio, which

flies only in the day; for the sphinx you told me no English name, but I remember it flies at sunset; and phalæna is the moth, and that flies at night.

Mother. One species of the papilio is the pretty little house butterfly, wtih which you are well acquainted.

Lucy. And the emperor moth is a species of the phalæna.

Mother. It is. To-morrow we shall proceed to another order.

DIALOGUE XII.

DEFINITION OF THE TERM GENUS. DISTINGUISHING MARKS OF THE FIRST ORDER, COLEOPTERA. ELYTRA. THORAX. ANTENNÆ.

LUCY. Mamma, I believe that I remember all you told me yesterday of the vegetable and animal kingdoms, and of their being divided into classes, and the classes into orders, the orders into genera, and the genera into species.

Mother. You have recollected very distinctly what I told you of these divisions; but do you understand the meaning of genera?

Lucy. I do not think you explained the exact meaning of that word; but I believe it is something like kind, as the

genera of moths are all creatures of one kind.

Mother. Genera is the plural of the term *genus*, a Latin word, which, strictly speaking, means a race, or family, or breed; but, like the terms class and order, it has been adopted in the various subdivisions of natural history, and denotes any collection of the different species, which agree in one or more essential characters. For example, in the genus of moths every species flies by night, and has taper antennæ; while the lesser peculiarities, such as the shape of the wings, the spots and colours, the length of the antennæ, or their being more or less feathered, mark the particular species. Genera, you perceive, is used to express more than one genus.

Lucy. Thank you, mamma; I now clearly understand, that the whole order, called lepidoptera, consists of three genera; first, the genus of butterflies; secondly, the genus of sphinges; and thirdly, the genus of moths.

Mother. And what is the distinguishing character common to all the three genera, which shows a fly to belong to this order.

Lucy. The having four scaly wings.

Mother. Perfectly right: I am satisfied that you do understand me clearly, and we will therefore advance a step farther.

The class of insects is divided into seven orders, of which the first is called *coleoptera.*

Lucy. Why did you begin with the third order instead of the first?

Mother. Because, my dear, your attention was first engaged by a moth, which you know belongs to the third order.

Lucy. What does *coleoptera* mean; is it also Greek?

Mother. The names of all the orders are borrowed from that language; and most of the terms in this and in every science are derived from either Latin or Greek. This materially promotes the

diffusion of knowledge, as those languages are familiar to all people of education.

Coleoptera is formed of two Greek words, one of which* means a sheath, the other† a wing. The distinguishing mark of this order, which is common to all the genera, is the having two sheaths, or wing cases; and, folded under these cases, two membranaceous wings; the sheaths are called *elytra*, or a single sheath *elytron*.

Lucy. Of what use are the wings, when squeezed up under these elytra?

Mother. The insect can, at pleasure, spread forward the elytra, and unfold its wings.

Lucy. So that it uses the elytra to fly with, as well as its wings?

Mother. It does; and in fact it has four wings, but only the membranaceous pair are termed wings; the others are called either elytra or sheaths, or sometimes (from the hardness of their structure) shells.

* *Coleos.* † *Pteron.*

Lucy. I understand the marks of the order; now, how are the genera known?

Mother. The division of the genera, in this order, is not so simple as it is in lepidoptera. The distinguishing marks for each genus are more numerous, and are taken, not only from the antennæ, but from the form of the elytra—the number of joints in each foot—the shape of the *thorax*—and the number of *palpi*.

Lucy. This order must be much more difficult than that of the lepidoptera: but what is the thorax?

Mother. The *thorax** is the part next to the head, and may be called the back of the breast; it is very variously marked, and is therefore a good guide in the division of the genera.

Lucy. I wish I could find one of these creatures, that I might see the shape of the thorax, and that I might look at the foot, for I cannot imagine

* A breastplate.

how such a little thing can be divided into joints.

Mother. In the larger species, the unassisted eye can see the joints plainly; but in those that are very minute, a microscope, you know, can render the smallest part visible.

Lucy. But why are not the antennæ a sufficient mark for these divisions?

Mother. Because sometimes the same form is common to the antennæ of two or three genera, which, in other peculiarities, are quite different from each other.

Lucy. And also, I suppose, because there are only three kinds of antennæ, and that there is a much greater number of genera.

Mother. That would be a good reason, if there were only three kinds of antennæ; but there are many others besides the three with which you are acquainted.

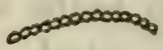
Lucy. Mamma, I think, if you would be so good as to draw for me those

I do not know, I could learn them by heart.

Mother. Very well, my dear, I will do so with pleasure. This

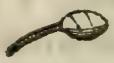
is called *filiform;* it is of the same thickness throughout, and the name is taken from the Latin word *filum,* a thread.

Moniliform, bead shaped,



from *monile,* a necklace, or string of beads.

Capitate, headed,



from *caput,* the head.

Fissile, divided, or split,

from *fissus,* a Latin word of that meaning.

Perfoliate, in layers, or laminæ.

Folium is the Latin for a leaf; and perfoliate signifies leaved, or laminated.

Aristate, or hair shaped,

from *arista,* a stiff hair, or the beard on an ear of corn.

Besides these, there are several less conspicuous distinctions; and sometimes two of these shapes are united. A German naturalist has enumerated even one hundred and sixty varieties: but those, which I have shown you, are the ten principal kinds; and you must remember them, Lucy, so as to use them as readily as you do the letters of the alphabet. Can you tell me those which you learned the other day?

Lucy. Yes, I can. The setaceous, or bristle-shaped; pectinated, or feathered; fusiform, or spindle shaped; and the clavated, or club-shaped. But, mamma, it seems to me, that there is very little difference between the bristle-shaped, and the hair-shaped antennæ.

Mother. The setaceous antennæ are distinguished by minute marks, which appear as if they were formed of rings jointed closely together; but in the aristatæ there are no such marks, and they more nearly resemble an eyelash than any thing else. Now, my love, we must go to our other occupations.

DIALOGUE XIII.

PALPI. GENERA OF THE ORDER COLEOPTERA. BEETLES, SCARABÆUS CARNIFEX.

MOTHER. Well, Lucy, I suppose you are by this time perfectly acquainted with the varieties of the antennæ, we may therefore go on with the other marks or characters, by which the genera are distinguished?

Lucy. Yes, mamma, if you please; I remember you said that these marks were taken from the joints of the foot, the shape of the thorax, and the number of palpi: but you did not explain what the palpi are.

Mother. *Palpi** are short feelers;

* From *Palpo*, to feel or touch gently.

they are *filiform*, that is thread shaped, and of equal thickness, they are also jointed so as to be very moveable. They are always placed at the mouth, and are *usually* four in number, though some species have only two, while others have so many as six.

Lucy. Of what use are these little feelers?

Mother. It is thought by naturalists, that it is with the palpi that insects smell; and they certainly seem to use them as guides, in regard to their food, as they never eat without having first patted and examined the substance all over with their palpi.

Lucy. That is very curious. Are there many genera, mamma, in this order of coleoptera?

Mother. Yes, my dear, a great number, more than thirty; and each genus has several species.

Lucy. Oh, mamma, I never shall be able to remember such a number.

Mother. Nor do I mean to tax your

memory so severely; there is no necessity to remember the names of all the genera. It is sufficient to be well acquainted with the marks which distinguish the order, and then, upon examination of any individual, you may, by reference to a proper book, readily discover its genus and particular species. If the parts of insects, and their various characters, are well fixed in your head, you will be surprised to find with how little trouble, and how much amusement, you will acquire the knowledge of a great number of the genera, by examining the insects which you chance to find.

Lucy. That indeed will be delightful; but you must describe some of the genera to me, that I may know how to set about examining them.

Mother. Willingly; we shall begin with the beetle, or *scarabæus,* which is the first genus, and of which there are several species. This genus is thus characterized: antennæ clavated, the extremities fissile, and five joints in the foot.

Lucy. How can the antennæ, be both clavated and fissile?

Mother. They are club shaped, but the club is divided lengthwise, like the stick of a fan, and these the creature can either keep folded together, or spread out.

Lucy. I perceive.

Mother. There are more than eighty species of scarabæoides, or beetles; but from this great number I will select a few to describe.

The *scarabœus carnifex* *, though not larger than a common sized beetle, is so strong as to move an astonishing weight. If you place one of them under the hollow foot of a tall candlestick, this little animal will move it from side to side, as if pushed by an invisible hand.

Lucy. Are these beetles pretty?

Mother. No, they are of a dull black colour, and more curious than beautiful; but their great strength is given for use-

* Executioner.

ful purposes. In September they lay their eggs, and place each of them in a ball of fresh dung: they form these balls with surprising assiduity, and then dig holes three feet deep in the ground to deposit them — a laborious operation, in which they work in concert: they afterwards assist each other in a singular manner to roll them along, moving backwards, and mutually shoving the balls with their hind feet.

Lucy. How wonderful! What pains the poor thing takes for the safety of its eggs; as much as the moth that plucks off its own down to cover them.

Mother. In spring a large worm comes from each egg, and makes its way to the surface of the ground; when this worm has lived its proper length of time it changes to a pupa, and from that to a perfect beetle.

Lucy. Then other insects, besides the moth and butterfly, pass through those changes?

Mother. There are very few insects

that do not undergo some transformation; and though all do not become pupæ, they pass some time in an intermediate state, between their being larvæ, and assuming their last and perfect form.

Another beetle, with which you are better acquainted, is the *cockchaffer*, or *scarabæus melolontha*.

Lucy. Is the cockchaffer a beetle? I never should have guessed that such large, buzzing, flying things were beetles.

Mother. Why are you so much surprised by a beetle's flying, when you have just heard that they are possessed of wings? Have you already forgotten the pretty lines you so lately learned?

Lucy. No indeed, mamma, I remember them very well:

> "Or where the beetle winds
> His small but sullen horn,
> As oft he rises 'midst the twilight path,
> Against the pilgrim borne in heedless hum."

But I did not think just then either of the lines or the wings.

Mother. That is what I suspected;

yet, to think is what above all other things I wish my Lucy to endeavour to do. Knowledge is of no use without reflection, and the attainment of the greatest collection of facts is merely time thrown away, unless we can readily apply them.

The cockchaffer must wait till tomorrow.

DIALOGUE XIV.

COCKCHAFFER, OR SCARABÆUS MELOLONTHA. ELEPHANT BEETLE, OR S. HERCULES.

LUCY. Now, mamma, for the cockchaffer, or (for I remember its grand name) the *scarabœus melolontha.*

Mother. Very well recollected. This cockchaffer, which is more commonly called the May-bug, lays about sixty eggs. They are of an oblong shape, and a bright yellow colour; and at the proper period it bores a deep hole in the earth, and places them at the bottom with the greatest regularity. In three months the larvæ are hatched.

Lucy. Three months! What a long time; and, when they do come out, what can they find to eat underground?

Mother. The roots and fibres of

plants, of which they destroy vast quantities, particularly of young corn; but even in this state they have their enemies, though from their situation you might think they were secure. Can you guess who are those enemies?

Lucy. Perhaps other worms, that are stronger: indeed I should say birds, if they were not concealed in the ground.

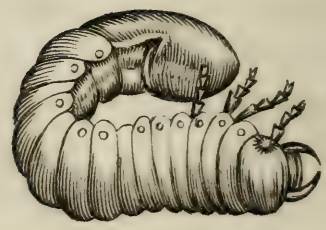
Mother. Your second guess, however, is right. Crows are particularly fond of these larvæ, and discover them by observing where the plants look sickly; then, with their strong bills, they dig into the earth near the roots of such plants, and seldom fail to find a rich repast. One year it was thought that the crows were doing infinite mischief to the greater part of the potatoe crops, and every means were taken by the short-sighted farmers to destroy these busy animals; at length some more accurate observers perceived, that they were employed as much in the service of the

farmer as in their own; and that it was not the potatoe, of which they were in search, but of these destructive worms, which swarmed during that summer to an unusual degree.

Lucy. I have often wondered to see rooks and gulls in such numbers stalking up and down the fields; but now I perceive they were seeking grubs and worms.

Mother. And you may observe, in fields that have been newly turned up, and even following close after the plough, a surprising number of crows, swallows, and wagtails, all engaged in the same employment.

This grub lives in its larva state during four years; when full grown it is an inch and a half long, very thick, and of a yellowish white, with a red head; the body consists of twelve rings or joints; it has six red feet; and it breathes through its stigmatæ, the number of which is eighteen, nine being placed



Larva of the Scarabæus Melolontha
or
Cock Chaffer.

Scarabæus Melolontha
the
Tree Beetle or Cock-chaffer.

Published November 1. 1818, by R. Hunter, St. Paul's Church Yard, London.

along each side. The head of this creature is remarkably large and strong, in proportion to its size, and is furnished with pincers and a sharp semicircular lip, with which it cuts and devours the roots of plants. As it lives under ground it seems to have no use for eyes, and accordingly we do not find that it is provided with any*.

Lucy. How then can the poor thing know where it is going?

Mother. By means of two feelers, with which it gropes its way. Possibly they contain also the organs of smell; so that these feelers may not only guide its subterraneous course, but serve likewise to discover the food best suited to its habits.

In the autumn of the fourth year, the grub, burying itself still deeper in the ground, sometimes even to six feet beneath the surface, excavates a sort of

* Plate V.

chamber, which it smooths and plasters very neatly. In this retreat it prepares for its approaching transformation, grows thicker but shorter, and at length, bursting the last skin, becomes a chrysalis.

Lucy. Well, mamma, I wonder how it ever rises again into the air; the grub can make its way through the ground with its strong head, but the beetle would be hurt in working upwards.

Mother. The beetle, you know, is covered with hard shells, which preserve its wings; and being very strong, it can without much difficulty travel through the toughest clay.

Its chrysalis state lasts for about three months: at first it is yellowish, but gradually deepens in colour to a dusky red; and in this state the fore part of the insect may be distinctly seen through the case, while the remainder looks as if wrapped in swaddling clothes. In January, the cockchaffer quits the chrysalis.

Lucy. So early! I thought no flies or beetles made their appearance before the mild weather of spring.

Mother. Nor does this beetle make its appearance in January; it only emerges from the chrysalis; and in this respect differs from most other insects; for it does not immediately attain its full strength, nor do the shells acquire their due hardness for three or four months, but remain soft, and have a brighter colour than in their perfect state: it also seems to lose for that period its voracious appetite, and appears sickly and inactive.

Lucy. And when they come out of their holes, what places do they frequent?

Mother. In the first warm evenings of May they issue from the ground; whence husbandmen call them May-bugs. Avoiding the heat of the sun, they repose during the day under the shade of those trees, the leaves of which they eat; but towards dusk they take wing, and fly in

mazy circles. The willow and oak are their favourite food, and in some years they completely strip those trees of their foliage.

Lucy. As they remain so long imprisoned in the ground, I suppose, mamma, they live many years in their perfect state?

Mother. Only one season; the cold at the beginning of winter kills them.

Lucy. They are safe, at least from birds, for their hard shells protect them.

Mother. Oh no, owls, bats, house sparrows, and turkeys, and their constant enemies the rooks, all devour them greedily.

Lucy. Thank you, mamma, for this entertaining account of the cockchaffer; its changes are indeed very curious.

Mother. The largest species of this genus, which has yet been found, is a native of South America, and is called the *elephant beetle,* or *scarabæus Hercules;* it is near four inches long, and the antennæ, which are hard and shelly, and

not moveable, are near an inch in length; but to compensate for its horny and unwieldy antennæ, it has a long and flexible *proboscis*.

Lucy. I should be delighted to see this wonderful monster, or at least a drawing of it.

Mother. Here is a drawing, that I made from one which was given, with some other curiosities, to your aunt Harriet.

Lucy. What a frightful animal! It really looks very fierce.

Mother. It certainly looks somewhat formidable. To-morrow we shall proceed to some of the other genera of coleoptera.

DIALOGUE XV.

STAG BEETLE, OR LUCANUS CERVUS. GARDEN TORTOISE BEETLE, OR CASSIDA VIRIDIS. LADYBIRD, OR COCCINELLA PUNCTATA. GLOW WORM, FIRE FLY, OR LAMPYRIS.

LUCY. Well, mamma, to-day we are to have some of the other genera in coleoptera.

Mother. The second genus consists of the *lucanidæ;* and that species of it called *lucanus cervus* *, or *stag beetle,* is the largest insect belonging to this order, that is found in Great Britain: it is thus described; the *antennæ* clavated, pectinated, and fissile; the *maxillæ,* or mandibles, extended like horns; and five joints in each foot †.

* *Cervus,* a stag.

† Plate VI.

Lucanus Cervus

the

Stag Beetle?

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Lucy. I know that clavated means club shaped, that fissile is divided, and that pectinated is feathered; but I wish you would explain how antennæ can be all three.

Mother. It is thus: the antennæ are club shaped; the clubs are divided, or split; and they are all slightly feathered along the edges.

Lucy. Thank you, mamma; now will you tell me what are the maxillæ?

Mother. They are jaws: in beetles they are placed outside of the face; and those of the stag beetle are very long, branched, or divided, so as to resemble in some degree the antlers of a stag, and *serrated*, or toothed like a saw, throughout their whole length. These jaws are sometimes as red as coral, which adds greatly to the beauty of this species of lucanus.

Lucy. What a terrible pinch they must give!

Mother. Yes, they are somewhat like

the claws of a lobster, and pinch most severely; and for that reason this beetle must be examined with great caution.

Lucy. I wish, however, that I could catch one: where are they likely to be found?

Mother. On oak trees, the sap of which these animals suck.

Lucy. But how do they get at the sap?

Mother. They strip off a small piece of the bark, and then fix their sharp jaws in the wood; through the wound, which is thus made, the juice flows, and they suck it in with their tongues.

Lucy. Do the larvæ of these stag beetles live on oak leaves?

Mother. No, they live under the bark, which also serves them for nourishment; and in this concealment they perform their chrysalis transformation.

We will now proceed to other genera.

Lucy. Stop one moment, mamma; in this box I have two pretty little crea-

tures, that I found in the garden this morning; pray tell me the name of this one.

Mother. It is the *cassida viridis* *, or, as it is commonly called, the *garden tortoise beetle,* not only from its shape, but from the power of drawing in its head, and concealing it under the shell like the tortoise. It was a very opportune discovery of yours, for it belongs to the order of which we are speaking.

Lucy. I found it creeping on a thistle stalk; I suppose it eats the leaves.

Mother. Probably; for it is generally found on that plant. The most curious circumstance respecting this species is the contrivance by which the larvæ shelter themselves from rain, or from a very hot sun; they actually make a little umbrella of dirt, which they support by means of their forked tail.

Now examine this cassida, and endeavour to describe it technically.

* *Viridis,* green.

Lucy. I believe the antennæ are moniliform, and also clavated; and that is all I can distinguish.

Mother. That is pretty well for a first attempt; but you may observe, that the elytra are margined or bordered, and so is the thorax; the power of concealing the head is also to be noticed.

Lucy. I understand; and I hope I shall do better the next time.

The other little animal I know is called a ladybird, or ladycow; and from its hard shells it also must be in the order coleoptera. It was flying, and alighted on a bush near me.

Mother. It is called *coccinella punctata**, and, as you know, is very common; some have red shells with black, or with white spots; others are black with red spots; and the smallest kinds are of a dull yellow speckled with black.

Lucy. Oh yes, I have often seen the

* From *Punctum*, a point, or speck.

little black and yellow sort: but where should I look for their larvæ?

Mother. Some species are found on flowers, and some on trees; but the larvæ of the most common kind, which has five black spots, is constantly seen on the common broad leaved dock; it is narrow, in proportion to its length, of a dark slate colour, with three red spots on each side, and with six legs; they seem to eat only the pulpy part of the leaf, as the veins remain like network where they have been feeding.

Lucy. I am sure these larvæ are what I call my fairy armadillos: you know the little armadillos in Bewick's Beasts?

Mother. They have a faint likeness to the armadillo; but now let me hear you describe the coccinella.

Lucy. Its antennæ are a little clavated, and they are not so long as the palpi. The shells and thorax, I see, are both margined.

Mother. Very right; now examine whether this book gives any farther characters.

Lucy. Yes, it says, body hemispheric; abdomen flat; three joints in each foot. What is hemispheric?

Mother. You know what a globe is; a *sphere* means the same thing. Now suppose a globe to be divided into two equal halves; each half would be called a *hemisphere*, or half sphere; thus you see this ladybird, being perfectly flat underneath, and its upper side having the form, as it were, of a half globe, is said to be *hemispheric.*

Lucy. That is very clear; now, what is abdomen?

Mother. *Abdomen* is the technical term applied by anatomists to that part of the body which contains the stomach and bowels.

You now understand your little friend the ladybird sufficiently; we will therefore proceed to that singular genus, *lam-*

pyris, or *fire fly*; of which I think you have seen one species.

Lucy. I, mamma! I do not recollect ever seeing a fire fly.

Mother. Do not you remember all the glow worms, that last year looked so beautiful in the evenings?

Lucy. Oh! I do indeed, in the shady elm avenue: and are they flies, or rather beetles?

Mother. They cannot properly be called either beetles or flies, but they have been in common conversation called fire flies, and are now well known by that name. The glow worm is the female of a species of lampyris, called *noctiluca** ; the abdomen consists of ten rings, from the three last of which the insect can, at pleasure, emit or withdraw its light. Though it possesses neither wings nor elytra, and differs but little in appearance from a caterpillar, it is, notwithstanding,

* From *Nox*, night, and *Lucus*, light.

an insect in the last, or perfect state: the head and *corselet* are formed exactly like those of the male, who is furnished with the proper wings and elytra, that characterize the order *.

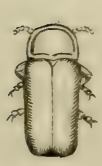
Lucy. Corselet; that is a new term, mamma.

Mother. It is sometimes used for thorax. The male lampyris has four luminous spots in the same situation as the female; in this country they afford a very feeble light, but in Italy their appearance, as they flit through the air on a dark night, is extremely beautiful. And in the West Indies these flies are so brilliant, that Mrs. Merian, when at Martinique, has frequently put two or three of them under a glass bell, and found that she could read a small print with ease, as long as they permitted their little lamps to give light.

Lucy. But what enables this singular creature to give light?

* Plate VII.

The Female



The Male

The Pupa

The Larva

Lampyris Noctiluca. The Glow Worm.

Published November 1, 1818, by R. Hunter, St. Paul's Church Yard, London.

Mother. Under the last ring of the abdomen there are two very small reservoirs of a thick, oily fluid, which, if the animal is crushed, leaves a luminous trace, that continues to give light till it dries.

Lucy. So, mamma, the glow worm supplies her pretty little lamp with oil, as we do our lamps?

Mother. I did not mean that the luminous matter is literally oil, nor that the light is produced by combustion, or burning, like the flame of a lamp; indeed it does not appear to possess any sensible heat. Some philosophers have supposed that it contains a small portion of phosphorus, others are of a different opinion, and hereafter you will read with pleasure their experiments and their theories. Neither have naturalists ascertained by what means the insects, that emit light, have the faculty of concealing or extinguishing it.

I will repeat to you some pretty

lines on the subject of this splendid insect.

"Beneath the friendly covert of the sky,
Wing'd his illumin'd way the fire fly;
Swift as his rays advance, or swift retire,
The living meteor tracks the night with fire;
Now, with instinctive art, conceals, now shows
Th' uncertain light which from his body glows."

DIALOGUE XVI.

PLUNGER BEETLE, OR DYTISCUS MARGINALIS. BOMBARDIER BEETLE, OR CARABUS CREPITANS. BLISTER FLY, OR MELOE VESICATORIUS.

MOTHER. Our last conversation ended with the little winged lamps, that adorn the night: we will now speak of a very different genus, which dwells chiefly in water.

Lucy. In water! I thought that when once insects had reached the flying state they quitted the water for ever.

Mother. All those, which have naked wings, must do so, as the water would render them unfit for flying; but several kinds have shelly cases for the protection of their wings, and continue to live in the water after they have acquired the

power of flying. Though it is generally late in the evening when they take wing, I had the pleasure of seeing the beetle, from which I made this drawing*, fly away in the bright sunshine.

Lucy. Oh! pray describe how it flew; were the wings large when opened out? what colour were they?

Mother. Having finished my sketch, I placed the little creature upon the window stool; in a few minutes it slowly stretched asunder the elytra, under which you know the wings are nicely folded; it then suddenly expanded its wings, and rising with a loud humming noise, it described large circles in the air, and was soon out of sight. The wings were large and membranaceous, and so beautifully varnished, that, as the sun shone upon them, they glistened like gold.

Lucy. How beautiful! does the larva live in the water as well as the perfect insect?

* Plate VIII.

The Larva.

Dytiscus Marginalis
the
Plunger or Diver.

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Mother. Yes; and I was so fortunate as to catch one of them, which I have also drawn?

Lucy. The horrid looking fellow! What a voracious look it has!

Mother. It is indeed a voracious creature, for it preys even upon its own species; and, from its murderous disposition, the French call it the assassin worm. When the insect lays her eggs, which are of a large size, she spins round them a case, of a coarse, dusky coloured kind of silk, which preserves them from the attacks of the larvæ, and of other hostile animals.

Lucy. What is the name of this little tiger?

Mother. *Dytiscus* is the name of the genus; it is sometimes called the *plunger*, or *diver*, from the rapidity, with which it darts downwards in the water. The *dytiscus marginalis** is the particular species represented in the drawing. When it

* So called from its border, or margin.

first arrives at its perfect state, the elytra are almost transparent, and beautifully varied with bright, changeable shades of dun colour and green; they afterwards become thicker, and turn to a dull olive.

Lucy. It looks so terrific, that I should be almost afraid to catch one of them.

Mother. They pinch violently with their jaws; and they have, besides, a strong spine placed under the thorax, and pointing backwards, with which they contrive to wound severely.

Lucy. Is the perfect dytiscus as ravenous as the larva?

Mother. Quite as much so; it devours every sort of water insect, not excepting its own larva.

I will now proceed to the genus *carabus*, which contains a great many species; but I shall only mention one, the *crepitans**, or, more commonly, the *bombardier*.

* Crackling.

Lucy. What a very droll name, mamma; what does it mean?

Mother. Bombs are hollow iron balls, filled with gunpowder: they burst at a distance from the place whence they are thrown, with a very loud report, and do great execution: they are generally used in the attack on fortified towns, and the men, whose business it is to fire them from mortars, or short, wide cannon, are called bombardiers.

Our beetle bombardier has been thus named from a singular noise which it is enabled to make, as a means of defence. It is seldom known to use its wings, but moves by a sort of jump; and when pursued, or touched, its assailant is surprized by a sudden noise, like the discharge of a diminutive mortar or bomb.

Lucy. A most excellent name for it, indeed.

Mother. A gentleman, who took some pains to observe this animal, says, that by scratching it with a pin, it can be

made to give twenty successive discharges.

The constant enemy of this carabus is another, but much larger species of the same genus; when in great danger it lies down till its pursuer has, with open mouth, approached quite close, when it discharges its little gun, accompanied by a puff of blue smoke; the large carabus, alarmed, draws back, and the bombardier instantly endeavours to conceal itself; but if it fails in finding some friendly crevice, its former stratagem has no longer any effect, and the enemy rushes forward, seizes its head, and tears it off.

Lucy. Oh, poor bombardier! What a sad death! It would be cruel sport, mamma, I confess, but I should like to see the battle.

Mother. These beetles are generally found under stones, and are thus described. Antennæ setaceous; thorax heart shaped and marginated; elytra

marginated; head, thorax, and legs iron colour; and the elytra black.

The *meloe* is the next genus for our observation: it is divided into two families; one of which has very short elytra, and no wings; in the other, the elytra are shorter than the body, but form the covering of the wings. Of both families there are several species: the *meloe vesicatorius*, or *blister fly* is one of the most beautiful; its colour is changeable, green, azure, and gold, predominating by turns; it is nearly an inch in length; flies in large swarms; and emits so strong a smell as to be easily traced by those who want to catch it*.

Lucy. But why should any one want to catch these pretty little creatures, except to examine them?

Mother. They are employed in medicine. An extract is made by infusing them in spirits of wine, which is sometimes taken internally; but they are

* Plate IX.

chiefly used as an external application. You have heard of a blistering plaster?

Lucy. Oh yes, I have seen one, and it was full of little bright green specks, that were very shining.

Mother. Those shining specks were small particles of these beetles, which were bruised and mixed with the proper ointment. They are often called Spanish flies, as if this species was peculiar to Spain; but they are found in many other countries, sometimes in England, about the ash trees, and the best are brought from Italy.

Now, my love, we must quit this amusing subject, till to-morrow. I must attend to your sister Fanny, and you may put on your bonnet, and tie up my carnations.

DIALOGUE XVII.

EARWIG, OR FORFICULA AURICULARIA. FORFICULA MINOR.

MOTHER. Thank you, my dear, for your good day's work of yesterday, for which I will reward you by a history of some insects, that are great assistants to you in gardening.

Lucy. I am sure I do not know of any insect that is useful in the garden; indeed, mamma, I think they all do harm.

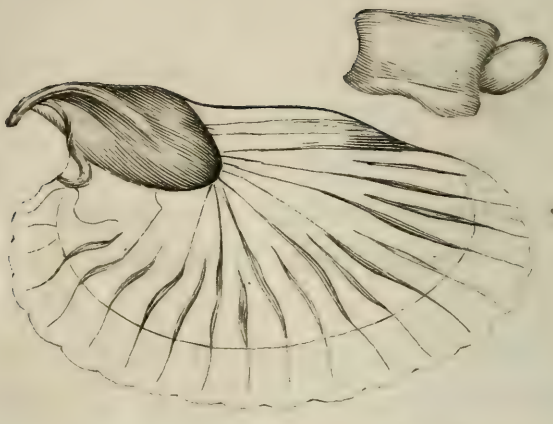
Mother. Not all; there are some which do good, by destroying other more hurtful insects, in the same way that birds are useful by eating the grubs; but in this case what would you think of your pretty little friend the *earwig*?

Lucy. Oh! mamma, my friend the earwig! the hateful creature; it is my enemy, and the enemy of my dear pinks; indeed I could have almost cried to see the flower-leaves scattered over the bed, and my best carnations spoiled. But, mamma, the earwig cannot belong to the order coleoptera, for where are the elytra?

Mother. It is provided with hard shells, or elytra, to preserve its wings. But if it had none, could you recollect any other insects that belong to this order, which have short elytra, or which are even unprovided with any?

Lucy. How foolish I am! the glow-worm, that is, the female of the fire-fly, has neither wings nor elytra; and the meloe, which you told me of yesterday, has very short elytra.

Mother. You perceive, Lucy, that if you allowed yourself time to think, you would not make such blunders. Now look on the chimney piece, and you will



An Earwig's wing and Elytron, Magnified.

Forficula Auricularia, the Earwig.

Meloë Vesicatorius, the Blister-fly.

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see a card with a watch crystal upon it —bring it carefully here.

Lucy. What a monstrous earwig there is under the crystal! I see, indeed, that it has short elytra.

Mother. Try to describe it.

Lucy. Antennæ, taper; elytra, short. Will you lend me your magnifying glass, that I may look at the feet?—Oh! I distinctly see three little joints in each foot. In the antennæ, I think I can reckon fourteen joints: how very delicate they are. In the last place, the tail is forked*.

Mother. Very well; but if you read this description, you will find one particular that you have omitted.

Lucy. "Shells tipt with white." I did not observe those little tips before; but the cases are so very short, that I cannot imagine how wings can be contained under them.

Mother. The wings are most curiously

* Plate IX.

folded; first, in plaits, like a fan; and then, in two places, they are folded across, so as to divide the length of the wing into three parts; when expanded, they extend the whole length of the body; but when closed up in these little packets they just fit under the elytra, which are only one third of their length.

Lucy. That is, indeed, very curious; I did not expect to be so amused in examining an odious earwig.

Mother. Every day's experience will furnish you with fresh proofs of the wonderful ingenuity and perfection of all the works of nature; a perfection displayed in the formation, even of the wing of the most insignificant and despised insect. There is another circumstance, which may serve to lessen your contempt for the *odious* earwig—the uncommon care it takes of its young. A naturalist, who was remarkable for accurate and patient observation, on disturbing an earwig, in the beginning of April, perceived, that she had been sitting on a heap of little white,

oval eggs; and taking her and the eggs, he put them, with some fresh earth, into a box. The eggs she speedily collected, and replaced them in a heap, on which she unremittingly sat till the middle of May, when her little progeny came out.

Lucy. Then the earwig hatches her eggs as a hen does. But what did she eat all the time that she was shut up in the box?

Mother. She was fed with apple pippins. When the larvæ came out, they resembled, in shape, the perfect insect, except that no wings nor elytra were to be seen; they were also thicker in the middle than at the head or tail, and nearly white, all but the eyes and teeth, which were red. They were so large, that it seemed hardly credible that they could have been contained in the eggs; and their skin was so transparent, that the beating of the artery, which runs along the back, was quite visible. They changed

their skins several times, as they grew larger; and each time they became of a darker brown.

Lucy. Mamma, I will certainly search for an earwig and its eggs. I will try to conquer my dislike, that I may see the little ones hatched.

Mother. Next spring, if you search under the stones in the garden, you will have a great chance of finding plenty of earwigs; but for this year you are too late, they have reared all their families, and are preparing to retire to their winter quarters.

Lucy. After the young ones came out of the eggs, did the mother continue to nurse them, as a hen would her chickens?

Mother. Yes; they nestled close under her, sometimes for hours together; and if alarmed, when running about, they immediately crept under her for protection.

Some of the little ones died, and were

speedily eaten up by those that remained: at last the mother died, and they devoured her also.

Lucy. Well, I think I may now call them *odious* earwigs.

Mother. But they have some excuse, for they had not been supplied with food: and hunger reconciles the strongest antipathies, even in mankind.

In July, the only remaining one went into its pupa state, and after a few days appeared a perfect earwig.

Lucy. What is the scientific name of the earwig?

Mother. *Forficula auricularia*; forficula, from its forked tail; and auricularia, from its supposed propensity to creep into the ear.

Lucy. Has it really that propensity?

Mother. Its common name bears that meaning in three different languages, and therefore seems to lend some probability to the idea; yet the instances of its having been found in the human ear are so very rare, that I imagine they arose from

chance rather than from habit: its general disposition to conceal itself in dark nooks and crevices may have led it there, without supposing any natural predilection for that place.

Lucy. Indeed, mamma, that seems very likely, as they hide in the lobsters claws and bean stalks, which the gardener puts as traps for them. Are there many species in this genus?

Mother. There is one other English species, the *forficula minor*, but it is not above a third part of the size of the common earwig; it is usually found near hot beds, and may be often seen about sunset, flying home, or creeping into the fine earth, which is spread upon melon beds. It is shaped exactly like the former kind, but of a pale chesnut colour.

This is the last genus of coleoptera, that I shall mention. The second order is called *hemiptera:* but this conversation has been rather long, and you seem tired.

Lucy. Indeed, mamma, I do not

feel in the least tired; I have been very much amused; and every day I find more and more pleasure in what you are teaching me. But I understood from you, that coleoptera was a very numerous order.

Mother. It is, my dear; and I therefore selected a few only of the most striking genera. After you have acquired a general idea of this delightful and instructive branch of natural history, you may prosecute the study of all the orders in greater detail.

DIALOGUE XVIII.

SECOND ORDER, HEMIPTERA. GRYLLUS. GRASSHOPPER, OR G. CAMPESTRIS. HOUSE CRICKET, OR G. DOMESTICUS. MOLE CRICKET, OR G. GRYLLOTALPA. LOCUST, OR G. MIGRATORIUS.

LUCY. To-day, mamma, we are to proceed to a new order—to hemiptera; and I hope it may contain as many curious particulars as we found in the first and third orders.

Mother. Although it does not comprise so many genera as there are in coleoptera, yet I think you will find in it a sufficient fund of gratification.

Hemiptera means *half-winged,* being derived from two Greek words, which signify *half* and *wing*.

Lucy. What! are the wings only half the right length for a wing?

Mother. Wings, my dear, are of no particular length; there are as many varieties of wings as of species; but the term *half* is used because the upper wings are half crustaceous, or shelly, and half membranaceous. Do you recollect the nature of the elytra in the order of coleoptera?

Lucy. Yes, they are hard, like shells, and they meet or join in a straight line down the back.

Mother. The elytra, in this order, are in their texture something like vellum, and there is only a slight appearance of the ribs, which in membranaceous wings are so distinctly seen: the elytra do not meet in a straight line, but lap over each other in a sloping direction; and in all the genera, the mouth, and the proboscis, or trunk, are bent inwards towards the breast.

The first genus we shall notice is the

gryllus; it is divided into several families, and each family contains several species; among which some musical acquaintances of yours are to be found.

Lucy. Musical acquaintances! You cannot mean the humming cockchaffers, for they are in coleoptera; perhaps you mean the large buzzing flies.

Mother. No, flies are not in this order: I allude to the *grasshopper*, which sings all day and all night; and to the *crickets*, which chirp so merrily near the fire. This genus is thus described:—Head bent inwards—armed with jaws, and furnished with palpi—antennæ, either filiform or setaceous—wings folded—hind legs formed for leaping.

Lucy. I have seen grasshoppers make monstrous jumps, when I have tried to catch them in the field.

Mother. The grasshopper, or *gryllus campestris* *, makes its habitation under

* From *Campus*, a field.

the roots of grass; the excavation is most curiously rounded and smoothed, and is made by means of its strong jaws, which are serrated, or toothed, like a lobster's claws.

Lucy. Do they pinch with these jaws?

Mother. They seem perfectly harmless when held in the hand; but they defend their dwellings from other grasshoppers with great spirit. Their singing noise is not made by the mouth, but by chafing the elytra together. Two grasshoppers have been known to vie with each other in the duration and shrillness of their song; and when unable to decide the contest, to have flown to arms, and fought till one of the combatants was killed.

Lucy. Well, I never should have thought of grasshoppers fighting duels.

Mother. In spring they begin to creep from their underground cells, and are then usually in their pupa state, with the wings folded under a transparent

membrane, which they throw off at their last change.

Lucy. Then the young grasshoppers do not pass through the grub or worm state?

Mother. No, they resemble the perfect insect, in shape; but are not possessed either of wings or elytra. About August they retire under ground, and are no longer seen or heard. In all the stages of their life they are harmless creatures, living chiefly upon grass and herbs, which they eat while wet with dew: but the *gryllus domesticus*, or *house cricket*, is not so easily satisfied.

Lucy. I have heard that house crickets eat bread.

Mother. Yes: they eat and drink almost every thing that is commonly left about a kitchen; of greasy water they are particularly fond; of leather also; and if any wet woollen cloths be left within their reach, they will make great havoc in them before morning.

Lucy. Young crickets, I suppose, like

the young grasshoppers, differ but little from the old ones.

Mother. In shape, they are very like; but at first they are white, and gradually become browner, as they advance in age. When they have increased in number, so as to find a want of room or food, they fly away in large companies in the evening, and form new colonies in other houses; generally choosing those which have been newly built, as they love damp walls, and can easily burrow in the soft mortar.

The *mole cricket, gryllus gryllotalpa**, is another species, well worth your attention, both for its curious form, and remarkable habits.

Lucy. I suppose, from its name, that it is shaped like a mole, with a long snout and claws, for boring through the ground.

Mother. Its claws have some resemblance to those of a mole; but we must first attend to its general characters.

* *Talpa*, a mole.

The colour is a dark brown—the head long and small—four thick, short palpi—antennæ filiform—thorax cylindrical, with a soft, velvety appearance—elytra short, strongly marked with black veins—wings very long and pointed—three joints in each foot—and the fore feet large and flat, ending in four large serrated claws, with which it burrows in swampy ground, and along the sides of canals and ponds *.

Lucy. You see, mamma, in that respect it is like a mole.

Mother. In May it makes its nest under the sward. This nest, in shape and size, is something like a small round snuff box, neatly smoothed and plastered: it has a long circuitous entrance, composed of winding passages and small caverns; and in the chamber the female deposits about a hundred eggs, which are of a dull yellow colour, and shaped like carraway comfits. These eggs are placed so near the surface of the ground, that they

* See Plate X.

Gryllus Gryllotalpa
the
Mole Cricket.

A fore claw of the
Mole Cricket.

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are hatched by the influence of the sun, while the mother posts herself at the entrance, to defend them from their greatest enemy, the black beetle.

The young crickets do much damage to kitchen gardens, destroying whole beds of cabbages and other vegetables.

Lucy. Does this species fly, like the other crickets?

Mother. Yes, in the evening they sometimes take long flights; but in the day time they are sluggish, and seem unwilling to use their wings.

Do you remember to have heard of *locusts?*

Lucy. Oh yes, several times. In the Bible you know it is said, that John the Baptist eat locusts and wild honey.

Mother. The locust is a large species of gryllus, which, happily for us, is not a native of England. It is called the *gryllus migratorius;* because it migrates or removes from country to country in vast bodies. They fly with the wind, and in such multitudes as to obscure the rays of the sun; and when they alight, the

ground is so completely covered, that even your little foot could not take a single step without crushing a considerable number.

Lucy. Are they like our grasshoppers?

Mother. In form they are, but much larger; there is a great variety also in their colours; some are of a dull yellow, spotted with black; some are green; and others are rose coloured, with black specks.

When they settle on the ground they rapidly devour every particle of herbage, corn, shrubs, trees, and even poisonous plants: the devastation is complete, and the effects are most calamitous, for a famine is the inevitable consequence. In Turkey, they are frequently the forerunners of the plague.

Yet in Arabia, and in many parts of Africa, the poorer classes of inhabitants hail the time of their coming as a season of abundance, and esteem them as delicious food. Thus you see, my dear Lucy, how the ravages of these destruc-

tive insects are, in some measure, counterbalanced by that transient benefit.

Lucy. Are they found only in those countries?

Mother. They are natives of all warm climates; and sometimes, being blown across the Mediterranean by a strong wind, they infest the southern part of Europe.

Lucy. I suppose they have never flown so far as England?

Mother. In the year 1748 we were visited by an alarming flight of locusts, but fortunately our climate was so cold, that few of them survived the autumn; all their larvæ perished in the winter; and since that period England has not been molested.

DIALOGUE XIX.

MANTIS. M. RELIGIOSA, OR SOOTHSAYER.
M. STRUMARIA, OR WALKING LEAF.

MOTHER. How do you like this drawing, Lucy?

Lucy. What a very odd looking thing! It resembles a tuft of leaves; yet it seems to have eyes, and legs. I think I see long antennæ; and this looks like the body. What is this strange creature called?

Mother. *Mantis** is the generic name, but in England it is commonly called the *soothsayer.*

Lucy. It is found then in England?

* A diviner, or prophet.

Mother. One species is reported to have been seen here, but so very rarely that the fact seems doubtful.

Of the whole genus it is said, that there are sixty-four species; many of them are natives of France and Italy, but the largest and most curious belong to the East Indies.

The *mantis religiosa* is common in Languedoc, and is much revered there by the simple peasantry, from whom it has obtained the name of the *pray-er;* for, frequently resting on the hinder legs, it raises the fore ones, and seems to fold them together, as if engaged in acts of devotion.

Lucy. You said, that it was also called soothsayer: what does that mean?

Mother. Sooth, in old English, is another word for truth, and fortunetellers were thence called soothsayers. Formerly superstitious people imagined, that this poor insect, by stretching out its legs, gave answers to their questions; and, by waving them to the right or to the left,

that it pointed out the road to travellers, particularly to children, who had lost their way.

Lucy. Is the larva as curious as the perfect insect?

Mother. It resembles the fly very much, except that it has no wings; which, during the pupa state, come to perfection, ready to unfold at its last change.

Lucy. Like the grasshoppers and crickets, I suppose?

Mother. Just so; the larva, the pupa, and the imago, or perfect fly, have so close a resemblance to each other, that an inattentive observer would scarcely perceive a difference.

This species of mantis piles up its little oblong eggs in regular rows, and roofs them with a substance like thin parchment, to protect them from the weather. Its colour is green when young, but it gradually changes to a brown.

There is another species, whose eggs are green, and about the size of coriander seed; they are deposited in a nest, which

Mantis Strumaria

the Broad-breasted Walking-leaf.

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is suspended to a small branch of a tree, and the larvæ and nymphs continue to inhabit this nest till they assume their last state.

Lucy. Do they feed on the leaves of trees, as they resemble them so strongly?

Mother. No; they prey on smaller insects, which that resemblance enables them to entrap with the greater facility. They are also very quarrelsome towards each other, and generally fight till one of the combatants is killed.

Lucy. What country produces the species in this drawing, mamma*?

Mother. South America. It is called *mantis strumaria,* and sometimes the *broad-breasted mantis,* or *walking leaf.* You may perceive how closely the elytra resemble the wings, in shape and size; and even in texture they are almost as membranaceous. The wings are very transparent, and their colour is chiefly

* Plate XI.

brown, but varied with a slight cast of green at the edges and tips.

Lucy. It looks surprisingly like a bundle of leaves fastened together by the stalks. It is a very curious animal indeed. Are the other kinds as large as this?

Mother. The *mantis gigas,* or *great mantis,* is still larger. It is a native of Amboyna, but very little is known of its history; so little, that we are not certain whether it is the larva or the perfect insect which has been sent to Europe, and which we find in collections of insects.

The *mantis siccifolia,* or *dry leaf mantis,* is also an inhabitant of the East Indies, and it is so like a leaf as to be very readily mistaken for one. Its wings are imperfect, but whether this arises from the specimens brought to Europe being larvæ, or whether, like several insects in the order coleoptera, and some species of bugs in hemiptera, they are only provided with elytra, has not been ascertained.

Now I will give you the description of the genus.

Lucy. I suppose, mamma, you mean, by description of the genus, the particularities which belong in common to all the species?

Mother. Yes, my dear; and when you have obtained a general knowledge of insects, you will derive great satisfaction from forming a more minute acquaintance with the peculiarities, which mark the different species. Now for our description of mantis. The head has an unsteady, nodding motion—mouth armed with jaws, and furnished with filiform palpi—antennæ setaceous—wings membranous, wrapped round the body, and the under pair folded—the legs serrated, or toothed like a saw; the first pair end in a single tooth; and the four others are of that kind called *gressorii.*

Lucy. That is another new term; pray explain it to me.

Mother. It is borrowed from a Latin

word*, which means a step, and is applied to those kinds of legs, which are adapted to slow motion only, such as walking step by step. Thus the legs of the mantis, which creeps along, are called *gressorii*, while those of the grasshopper, which leaps or jumps with great velocity, are termed *saltatorii*, from a Latin verb†, that signifies to leap.

Lucy. Thank you, mamma; I find it much easier to remember these terms when I know their exact meaning.

Mother. Before we part for to-day I will tell you one more circumstance of the mantis; I have already mentioned, that some of the species are very spirited and quarrelsome little creatures; and it is said, that in China, they are kept in cages, and fed, for the diversion of setting them to fight, in the same way that cockfighting is practised in this country by thoughtless clowns.

* *Gressus.* † *Salto.*

Lucy. What cruel diversions people find out!

Mother. Those barbarous sports proceed from ignorance and idleness; or from a still more pernicious disposition, the spirit of gambling.

Lucy. I thought gambling was playing with cards.

Mother. Gambling is not confined to cards or dice: he, who lays a wager on the swiftness of a racehorse, gambles; so does the Chinese gamester who bets on the success of an insect, and who sometimes stakes all he is worth, even the clothes upon his back. It is the same sordid propensity, my dear Lucy, which leads the higher ranks to the race course, or the lower classes to the cockpit, which induced the ancient Athenians to train their locusts for battle, and which tempts the modern China-man to hazard his all on the courage of a mantis.

DIALOGUE XX.

FULGORA, OR LANTERN FLY. F. LATERNARIA. F. CANDELARIA. NOTONECTA, OR BOAT FLY. NEPA, OR WATER SCORPION. N. CINEREA.

MOTHER. You were amused, Lucy, with the account of the lampyris, or fire fly; I think you will find that the *fulgora**, or *lantern fly*, which belongs to this order, is equally entertaining.

Lucy. Lantern fly! that is a curious name; but I suppose it carries a light, like the glow worm?

Mother. It does. One of the species, the *fulgora laternaria*† of Surinam, in South America, is a very large insect, almost three inches in length; the horny

* *Fulgo,* to glitter. † *Laterna,* a lantern.

front of the head projects into a sort of beak, resembling the bill of a duck, which is hollow, and extremely transparent; and from this little lantern the light is diffused.

Lucy. The light of the fulgora, then, I see, is very differently placed from that of the lampyris.

Mother. And it is far more vivid, for by the light of a single fly a small print may be distinctly read.

The elytra also are transparent, and variegated with green and brown; and its membranaceous wings are decorated with coloured spots, like the eyes in a peacock's tail.

Lucy. What a beautiful creature, mamma, even in the day time!

Mother. But at night, when myriads of those fulgoræ flit among the woods, you can scarcely conceive the brilliancy of the effect; at a little distance they appear like incessant flashes of faint lightning; and on a nearer approach their

transparent elytra and gauzy wings seem to enlarge each light, while they soften its splendour.

Another remarkable species of these luminous insects is the *fulgora candelaria** ; its light also proceeds from the head, the elytra are richly variegated with purple, black, and yellow, and the wings are of a dazzling orange. It is found in China, where the natives regard it with great veneration; and the poor Indians of Surinam show the same kind of superstitious reverence for the fulgora laternaria.

Lucy. I hope you have more circumstances to tell me about these wonderful creatures, they are so very curious!

Mother. If I were to dwell too long on each curious or wonderful species, our conversations would never finish; you know my intention is only to give you such a general knowledge of each order,

* From *Candela*, a candle.

as may enable you hereafter to follow up this instructive and highly entertaining study with greater ease and advantage.

We will therefore proceed to the *notonecta*, or *boat fly*.

Lucy. Is that the little bright black animal, like a beetle, that I have seen moving in circles on the pond?

Mother. No, that is the *gyrinus natator*, commonly called the *water-flea*, and belonging to the order coleoptera; but the notonecta, also, is found in ponds. It has the singular characteristic of swimming on its back, and from that circumstance it takes its name, which is derived from the Greek. The English name has been given from the resemblance of this insect to a little boat, the six legs appearing like so many oars, with which it rows along with amazing swiftness; and the hinder pair are fringed with stiff hairs, which seem to answer the same purpose that fins do to fish. It must be handled with great caution, for it is not only provided with a sting, but its beak,

or *rostrum*, is very sharp, and might give a very disagreeable wound.

Lucy. How then are these dangerous little creatures caught?

Mother. By means of a net with very small meshes, fastened to a hoop, and fixed to the end of a long handle. Many of the water insects are very ferocious, and the boat fly is peculiarly so; it pursues the smaller species with wonderful rapidity, and seizing them with its fore legs, darts in its rostrum, and then devours them.

Lucy. What sort of worms are their larvæ?

Mother. They very much resemble the perfect fly, but want its wings; and they undergo their changes in the soft banks of ponds.

Lucy. And when they have obtained their wings do they ever make use of them?

Mother. In sunshine they stretch themselves on the ground, and expand their wings in the sun, till they are dry;

they then fly merrily; but if fatigued, or pursued by birds, they drop at once, and dive into the water. Here is a drawing of a boat fly, the *notonecta glauca* *, which I caught in our pond †.

Lucy. It really is very like a tiny boat: perhaps the first thought of a boat was taken from this little animal.

Mother. It has been fancifully conjectured, that the first idea of navigation was borrowed from the *nautilus*, a little animal, whose beautiful white shell has in some degree the form of a ship, and which is also possessed of a thin membrane, that it can erect and spread out in the manner of a sail to catch the wind.

Lucy. Dear, mamma, where can I see one? I long to know something more of such a singular creature.

Mother. Your friend Sophy has a nautilus shell in her little collection of

* *Glaucus*, sea-green. † Plate XII.

natural curiosities; hereafter we will examine it; and when you are pretty well acquainted with insects, we may proceed to learn something of other animals; but, my dear Lucy, it will be much wiser to acquire a competent knowledge of one subject, than a smattering of many.

Lucy. Indeed, mamma, that is very true; but I hope that we may afterwards go through all the classes of the animal kingdom.

Mother. That will entirely depend upon your own industry.

What say you now? Shall we conclude to-day with the water scorpion, or shall we stop?

Lucy. Oh! the water scorpion, if you can spare time.

Mother. The *nepa*, or *water scorpion*, like the boat fly, lives in ponds and pools, where, in all the stages of its life, it preys upon weaker insects. It is thus described: the fore legs are claw shaped, like those of a crab—the wings and elytra

are crossed over the body—the elytra near the thorax are of a leathery consistence—the hinder pair of legs are hairy—and it has only one joint in each foot.

Lucy. You have not mentioned the antennæ.

Mother. It has no distinct antennæ; but it seems doubtful whether the fore legs are truly legs, or whether they are not rather antennæ, as the creature always walks upon the other four legs*.

The *nepa cinerea*†, the most common species, drops its eggs into the hollow stalks of bull-rushes, where they lie concealed; these eggs are of an oval shape, and have at one end two or three hairs, or bristles. Both the larva and the perfect nepa are fierce and voracious; the latter swims very swiftly, seizes its prey with the fore legs, and holding it fast with its pincer-shaped claws, tears it and sucks its blood with the sharp rostrum, or

* Plate XII.

† *Cinereus,* ash coloured.

beak. It has even been observed to destroy small water insects, without attempting to eat them.

Lucy. These are as savage creatures as the dytiscus; I should not like to take one up, or indeed to meet them flying, if they ever do fly.

Mother. Yes, they frequently fly on fine evenings; and sometimes rising in large companies, they quit their native pond, and remove to another.

Lucy. As soon, I suppose, as they have devoured all the creatures that are not too strong for them to catch.

Mother. That may very possibly be the reason; or they may have increased to such a number as to make it adviseable for a colony of adventurers to emigrate. Now, my love, you have heard all that is necessary of the history of the water scorpion; to-morrow we shall make the bug our subject.

Lucy. Bugs are odious creatures; I am sure very little that is entertaining

back
the wings extended.

appearance
as it swims on its back.

Notonecta Glauca. The common Boat Fly.

Nepa Cinerea. The Water Scorpion.
as in the water. *wings extended.*

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can be said of them: but so I thought of earwigs, and yet I was delighted with their history. Good bye, mamma, I must now go and dig up my bulbous roots.

Mother. Farewell, Lucy, I wish you success.

DIALOGUE XXI.

CIMEX, OR BUG. C. LECTULARIUS. C. PARADOXUS. C. STAGNORUM. C. LACUSTRIS.

LUCY. Here I come, mamma, to hear the history of the bug.

Mother. And here am I ready to tell you, that there are a vast number of different species in this genus of *cimex*, or *bug*. Some of them are without wings, some seem to have imperfect wings, and some have wings, but no elytra. The most common kind is the bed bug, *cimex lectularius**, with which I hope you are not much acquainted.

Lucy. I have heard that they bite

* From *Lectus*, a bed.

terribly, and raise large bumps on the skin. Is there no way of destroying them?

Mother. It is difficult to find them, as on the approach of daylight they conceal themselves in the joints of the bedstead. Turpentine, camphor, and several other strong smelling drugs are said to be fatal to them, but the eggs are so small, and always placed in such safe nooks, that they easily escape the effect of these applications, and in a short time people it afresh. I understand the surest method of destroying them is to wash the bedstead with a solution of corrosive sublimate, which readily enters the crevices.

Lucy. Has this species wings?

Mother. It is said that they have sometimes been found possessed of wings; but fortunately this very rarely happens.

The rostrum or beak of the cimex is bent downwards and backwards—antennæ longer than the thorax—wings folded

together cross-wise — elytra *coriaceous*, or leatherlike, for half their length — thorax margined — back flat — and the feet formed for running, with three joints in each *.

Lucy. But, mamma, this general description will not answer for the bed-bugs, for they have no wings.

Mother. Except in that particular, it will apply to them, and you know it is said, that they sometimes have wings; but in this respect there is much variety in the bug tribe; some species have their elytra coriaceous throughout; while in others the elytra are membranaceous, like the wings.

Lucy. It must be a very difficult genus to understand. If I were to catch a bug I should scarcely know how to find out its name, or, perhaps, even its order.

Mother. We will try. Ring the bell; I will send Thomas with this little net,

* Plate XIII.

and this deep glass to the garden pond, for some of the longlegged creatures you observed there yesterday.

While we are waiting for his return, we need not be idle. "*Sauver nos quarts d'heures,*" is an excellent French saying.

Lucy. I suppose the larvæ of bugs like those of the crickets, and the boat flies, and all the creatures you have mentioned in this order, resemble the perfect insects?

Mother. Yes, the young bugs, both when larvæ and when chrysalids, are extremely like their perfect parent; as larvæ they have no wings, as chrysalids they have the rudiments of wings, which, when they cast their chrysalis skin, have attained the full size, and are fit for use.

Lucy. And are they ever seen flying?

Mother. Some species fly very well, and are frequently caught in woods; one very curious sort, the *cimex paradoxus,* was found at the Cape of Good Hope by

an eminent naturalist, Dr. Sparman, who had retired from the heat of the sun, under the shade of some trees. The weather was so calm that not a leaf stirred; yet, after some time, he observed as he thought a little brown leaf moving through the air, as if blown from a tree; this excited his curiosity, and on examination he found that it was a cimex, of a pale brown colour, like a withered leaf, with the edges crumpled, and looking as if gnawed by caterpillars; but thickly beset all over with small prickles. Assisted by this mask it could fly about in security, as birds, the enemies of all the insect race, would probably pass by, unheeding a crumpled, faded leaf. Thus you see that every creature, however insignificant it may appear to us, is endued, by the goodness of Providence, with the means either of defence, of escape, or of concealment*.

Lucy. This is indeed one of the most

* Plate XIII.

surprising insects I have yet heard of. But here is Thomas, with the little creatures from the pond.

Mother. Examine this one, and tell me what particularities you observe; begin with the head.

Lucy. The head is very long, and the antennæ seem to be the same length; how very slender they are!

Mother. Look at the eyes.

Lucy. I see they are excessively small, and yet project very much.

Mother. Very well; proceed.

Lucy. Its two fore legs are much shorter than the others; the thorax is margined; and by the help of this glass I can see three little joints in each foot. What a dark brown it is! and how narrow the whole creature is for its length!

Mother. Now if you read the description in this book, you will see that it agrees with your own remarks.

Lucy. "Stagnorum. Dark brown

—long and slender—head one third of its whole length—antennæ as long as the head, and very small—eyes minute, prominent—fore legs short—length half an inch—on pools*." Indeed it does agree exactly.

Mother. You may observe that *cimex*, the generic name, is placed as a title to the whole tribe; and the descriptions of the several species follow, each beginning with the specific name. Thus *stagnorum* stands at the head of the article which you have just read; that name distinguishes this species, and was applied to it from the circumstance of its living on stagnant water; *cimex stagnorum* signifying, literally, the bug of ponds or marshes.

Lucy. Thank you, mamma; I understand this very well. I see that the specific names are of the same kind of use as our Christian names.

* Plate XIII.

Mother. Yes, exactly.

Lucy. The next species, in this book, is called *lacustris;* what does that mean?

Mother. *Lacus* means a lake, the place inhabited by that species of cimex. Here is a drawing of the cimex lacustris*; it is larger than the stagnorum, and much more lively; it sports with surprising activity on the surface of the water, which, from the extreme lightness of its body, is scarcely dimpled by its motions.

Lucy. Does it live under the water?

Mother. Very seldom; it seems to prefer being near the bank: it sometimes stands quite still for several minutes, its six legs stretched out, and just the soles of its tiny feet touching the water, when suddenly it darts away.

Lucy. And does not the stagnorum run upon the water.

Mother. No; its motions are slow and cautious; it seems always to fear some danger, and often stops and appears

* Plate XIII.

to look round; should it perceive any thing alarming, it immediately retires.

Lucy. These creatures are very light to be sure, but yet it seems surprising that they never sink.

Mother. Many aquatic insects have a power of exuding, or throwing out, an oily matter from different parts of the body; thus the water bugs possess the property of oiling their legs, which increases their buoyancy.

Lucy. What very curious insects in the order hemiptera!

Mother. There are several other genera in this order, which are not less remarkable in their habits and modes of life; but I reserve these for your future amusement, and to-morrow we shall proceed to another order.

Cimex Lectularius
the Bed Bug.

Cimex Lacustris
the Lake Bug

Cimex Stagnorum
the Stagnant water Bug.

Cimex Paradoxus
the Withered Leaf Bug.

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DIALOGUE XXII.

FOURTH ORDER, NEUROPTERA. LIBELLULA, OR DRAGON FLY. EPHEMERA.

LUCY. Now, mamma, we are to begin the fourth order, for we have already gone through the third, called lepidoptera.

Mother. Can you tell me the names of the two first orders, and their meaning?

Lucy. The first order is coleoptera, and the name is formed of two Greek words, which signify a sheath, and a wing: it contains all the beetles, and other insects that have horny wing cases.

Mother. Very well; and the second order?

Lucy. Is hemiptera, from Greek words, which mean half, and wing; because the upper wings, or elytra, are

generally half membranaceous, and the other half are like vellum.

Mother. Which half is usually like vellum?

Lucy. That next the breast. The third order is lepidoptera, which means, that the wings are covered with feathery scales.

And now, what is the name of the fourth order?

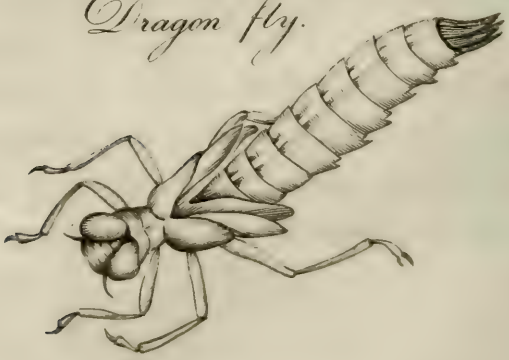
Mother. *Neuroptera.* The Greek words of which it is composed signify a nerve * and a wing †. The flies belonging to this order have four transparent wings, which are naked and membranaceous.

Lucy. But beetles also have membranaceous wings?

Mother. *Two* only; and they are not so thickly set with nerves as the wings of the neuropterous insects, which are like the most beautiful net work, or the finest gauze.

* *Neuron.* † *Pteron.*

Libellula Depressa.
Dragon fly.



Larva of the Libellula Depressa.

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Lucy. I see the distinction; and, mamma, I will venture to say, that the dragon flies are in this order.

Mother. You are quite right; the *libellula,* or *dragon fly** is the first genus belonging to this order; it comprises several species, some of which are very beautiful. In their larva state they inhabit the water.

Lucy. How many beautiful creatures live in the water! I had no notion that flies, which have no wing cases, could have lived there.

Mother. They have no wings, you know, when larvæ; they are then disagreeable looking animals, of a pale greenish brown colour, with six legs, and bearing a resemblance to the larva of the dytiscus, but their bodies are more slender. They are voracious, and may even be called cruel, since they seize on every insect they can catch, and mangle without tasting them.

* Plate XIV.

Lucy. Indeed, insects, however beautiful, are not very amiable animals, for almost every kind preys upon its neighbours.

Mother. This seems to have been ordained by Providence as a means of preventing too great an increase of any one kind.

These larvæ are produced from eggs, which the dragon fly drops upon the surface of the water, and which, sinking to the bottom, are hatched in the sand or gravel: but they continue only a short part of their watery life in the state of larvæ, and soon change to nymphs.

Lucy. I suppose they are not so voracious in the pupa state?

Mother. They retain all their powers of eating, running, and swimming; and even acquire a sort of mask, or shield, which is attached to the head, and behind which they devour their prey.

Lucy. How long do they continue in the water?

Mother. Nearly two years. When

the time for their last change is arrrived, they crawl out of the water, and walk about for some time, as if to dry their skins; they then creep up on a twig or large rush, and, having carefully examined it all over, fix themselves to it near the top. As the skin dries it seems to shrink, till, by a slight effort, the fly splits it along the back, and disengaging itself, stands fluttering till the wings are fully expanded, when it flies away to rejoice in air and sunshine.

Lucy. And when they become flies, do they prey upon other insects?

Mother. Yes; the larger species devour moths; and the smaller live on little flies.

There is an insect called *ephemera**, or sometimes the *Day fly*, the larvæ of which also live in the water, and that for a great length of time.

Lucy. Longer than the larva of the dragon fly?

* A creature, which exists but one day.

Mother. Some of the species pass three, and even five years in the water, or rather in the muddy banks of rivers, below their surface. The flies, as they skim along the water, drop their little eggs, which, falling to the bottom, are in a few days hatched; and no sooner does the worm come forth, than it creeps or swims to the bank, and burrows out a hole to live in. This work it performs with the more ease, as it has not the labour of carrying away the clay or mud, which it removes.

Lucy. What then can these worms do with the clay?

Mother. They eat it.

Lucy. That is like the caterpillars, who live under the bark of trees, and eat out the wood as they form their houses; but to eat mud, seems to be a very singular taste indeed.

Mother. Yes, these circumstances do appear very singular at first sight; but we find that every part of the creation is so wonderfully arranged, that there are few

substances which do not in some way contribute to the support, or serve for the food of animal life. The ship-worm, for instance, lives on hard timber, which has been so many years cut down and seasoned, that all nourishment might naturally be supposed to have been dried up; yet many a ship has been lost by the ravages of these diminutive enemies. There are even creatures, which feed upon the stone in which they excavate their dwelling places.

Lucy. Oh! mamma, you are determined to surprise me to day; mud, and old timber were, I thought, very singular kinds of food; but to eat stone is still more amazing.

Mother. Each fact is in itself sufficiently surprising; but when we collect into one view the numberless contrivances employed throughout the animal world, our minds are then indeed lost in astonishment and veneration.

But to return to the ephemera; after

eating into the bank to a certain distance, it works its way back again to the water in the same manner; and sometimes the whole bank of a river may be found bored with these little holes, each shaped like a U.

Lucy. But, mamma, how was it discovered, that these little creatures, who are always under the water, swallowed the mud, instead of throwing it away?

Mother. Their skin is so very transparent, that, with the assistance of a magnifying glass, the intestines may be plainly seen to be filled with the clay into which they had penetrated.

Their bodies* are long in proportion to their breadth, and are divided into nine rings: the head is furnished with two antennæ, placed before the eyes; and with two strong, horny, bent claws, with which they dig out the clay. They have three pair of legs, and run very briskly:

* Plate XV.

on each side of the body are ranged a number of little membranes, through which it is supposed the animal breathes, as they have always a tremulous motion, and slightly resemble the gills of a fish.

Lucy. I suppose they breathe through their sides, as caterpillars do through the stigmatæ?

Mother. Yes, my love, that is just the case. At the tail there are two or three long filaments, which appear like feathered antennæ; and it has been ascertained, that every one of these little feathers contains two tubes, which it is imagined are also used in breathing.

Lucy. But, mamma, if they breathe through these little tubes, why does not the water go into them along with the air?

Mother. The tubes are so exceedingly minute, that probably water cannot be divided into particles sufficiently small, to be capable of entering; but as air can be contained in the smallest imaginable

space, these tiny tubes may serve to separate the air from the water.

Some of the species remain only two years as larvæ, while others continue so for five years.

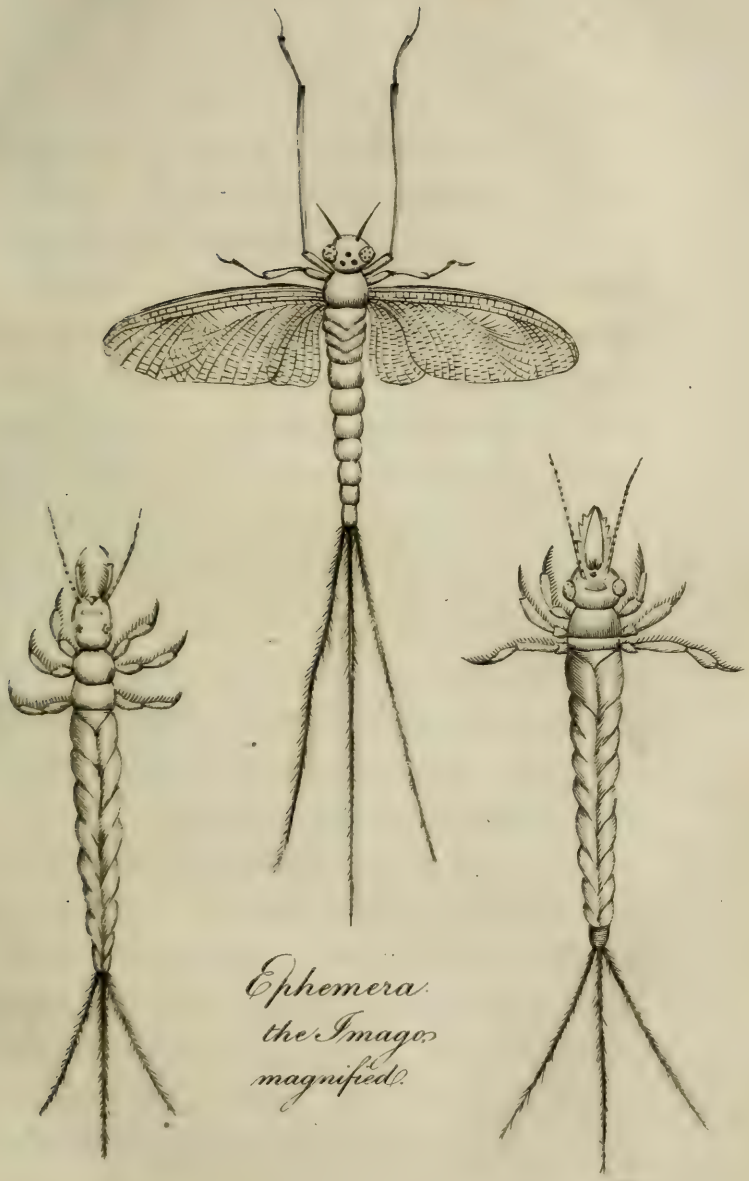
Lucy. And are they all alike in figure?

Mother. No, they differ as to size, and in some particulars as to shape; but they have all a general resemblance, particularly in the breathing fins, with which every species is furnished.

Lucy. Do they remain long in the pupa state?

Mother. It is necessary to observe, that in those insects, where the appearance of the pupa scarcely varies from that of the larva and the imago, this intermediate stage of life is most usually called the *nymph* state.

Most species of ephemera continue for three months in that state, the chief difference of which from the larva is the acquisition of wings, nicely folded up under small cases next the thorax.



Ephemera.
the Imago.
magnified.

The Larva
magnified.

The Nymph
magnified.

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At length the destined time comes, the perfect fly rises to the surface of the water, disengages itself from the nymph skin, and instantly darts away.

Lucy. I should like greatly to see them at that moment.

Mother. This process generally takes place in the evening, or during the night; each species having its fixed hour for changing. Those belonging to the river Seine, in France, change in the beginning of August, between nine and eleven at night; while those of the Rhine, in Germany, take wing about two hours before sunset. In some parts of Germany their numbers are so prodigious, that they are used by the gardeners as manure.

Lucy. But how can they catch such swift little creatures?

Mother. Several kinds of them live but three hours; some but a single day; and even the most long-lived species only for three days. As they have no time for eating, so they are unprovided with a mouth, or any mode of ob-

taining food. Their transient existence is spent in the air, and all that are not devoured by beetles and birds, fall to the ground, and die.

Lucy. I suppose that the people wait till they fall, and then sweep them up in heaps, in order to remove them to their gardens. Are they ever seen in such abundance in this country?

Mother. No, I believe not: in the evenings, however, near river banks, considerable numbers may be observed.

Now, my dear, we must part: we have had so long a conversation, that I fear you will hardly remember all I have told you.

Lucy. Indeed, mamma, I can hardly forget what has entertained me so very much.

DIALOGUE XXIII.

PHRYGANEA, OR SPRING FLY. MYRMELEON FORMICARIUS, OR FORMICA LEO, OR LION ANT.

MOTHER. The genus I shall first mention to-day is called *phryganea*, or, vulgarly, *spring fly*. During its larva state it lives in the water; its shape is that of a long worm with six legs; and it spins about itself a silken tube, wide enough to turn round in, so that it can put out its head at the aperture in either end.

Lucy. The silken case must be so light, that perhaps the worm can swim about with its house on its back?

Mother. It is indeed so light, that the little creature cannot without some

contrivance sink itself to the bottom of the water, in search of its prey. For this purpose it glues to the outside of the case, grains of sand, gravel, or small shells, which increases its *specific gravity*, or weight, and enables it to dive; if it happens to have glued on so many as to make its house too heavy to float, then it sticks on, in addition, bits of straw, or rotten wood, or grass; thus endeavouring to keep itself exactly suspended in the water; by which means it can both run, and swim, and sink with equal ease.

When preparing to change to a chrysalis, it weaves a slight net across each end of the tube, sufficiently open to admit the water, but strong enough to exclude other voracious insects*.

Lucy. As it preys on smaller insects, it is very fair that it should be devoured in turn by the larvæ of others.

Mother. But they are sought after by men, as well as by insects.

* Plate XVI.

Phryganea Rhombica. Spring Fly.

The case
opened to shew the Pupa.

The case
and Larva.

The Larva
taken
out of the case.

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Lucy. By men! for what purpose? to eat?

Mother. No, no; fishermen make use of them for bait; they are called stone bait, and are eagerly swallowed by trout. In the chrysalis state the phryganea is enveloped withinside the rough outer case, by a web of fine net-work, so transparent that the perfect fly may be distinctly seen. When about to become an inhabitant of the air, it raises its tube to the surface of the water, quits at once both the outward case and the delicate chrysalis covering, and emerges a beautiful fly; in this state it generally avoids the bright sun, and flutters amidst the flowers, or settles upon the leaves and branches in shady places.

Lucy. It seems strange that such a number of beautiful flies should first have been ugly water worms. Do all the larvæ of the order neuroptera live in the water?

Mother. Not all. There are several genera, that in each of the stages of their

life inhabit the ground. The *myrmeleon*, for instance, always lives in dry, sandy soils.

Lucy. Has this insect an English name?

Mother. The singular species, the *myrmeleon formicarius*, or *formica leo**, of which I am now going to give you an account, is sometimes called the *lion ant*, because, when in its larva state, it preys upon ants, as lions do on weaker animals.

Lucy. Ants run so fast, that this little lion must be very nimble to catch them.

Mother. Far otherwise; it moves remarkably slowly, and its limbs are so formed that it can walk backward only, with any degree of facility.

Lucy. How then can it catch the swift-footed ant?

Mother. By stratagem: but I will first describe this little animal. It has

* *Formica*, the ant.

a remarkably large abdomen, which is divided into eleven narrow rings, slightly covered with short stiff hairs; the head is flat, and from it extend two curved and toothed horns, very hard and strong, and tapered to a sharp point, and the insect can at pleasure spread them open, or close them till the points cross.

Lucy. They seem to be something like the horns of the stag beetle.

Mother. In some respects they are; but the stag beetle is also provided with jaws, and with a mouth, while the lion ant has neither. Those pincers are hollow, and not only serve to grasp the little animals it catches, but likewise to suck in their juices; for as it has no mouth it cannot eat, and it never tears, or mangles its prey. At the base of these pincers are placed the eyes; and without the assistance of a microscope each of them appears to be single, but when sufficiently magnified, six small brilliant eyes are distinctly seen to be contained in each socket.

Lucy. Six eyes together! so then it has twelve. What can be the use of so many?

Mother. Few insects are endowed with the power of moving the eyes, as birds, and the larger animals are; but to compensate for this deficiency some are furnished with several small eyes, which are all comprised under one transparent membrane, and so varied in position as to take in objects in different directions; in other insects this transparent covering is divided into a great number of minute projections, each of which seems to have equally the power of vision. By these means insects see in every direction without turning their eyes.

Lucy. That is indeed a most wonderful property of insects!

Mother. Close to the formica leo's eyes are two antennæ, so fine that they are scarcely visible. The head is joined to the thorax by a long neck, consisting of two or three rings, which are so contrived as to push in and draw out, like

Myrmeleon Formicarius
the
Lion Ant,
in the
perfect and in the Larva state.

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the tubes of a pocket telescope, thus enabling the animal to draw back its head close to the thorax, or to extend it forwards in order to seize its prey. The two fore legs are short, and point forwards; the second pair are longer; the third pair longer still, and furnished with bent, horny feet, or rather hooks, by means of which it draws itself backward *.

Lucy. Now, mamma, we shall come to the method of catching its prey.

Mother. It lies in ambush for that purpose in the following manner: with its strong horns it digs a hole in the dry sand, the kind of soil in which it always lives: this hole is shaped like a funnel, and the sand, which has been thrown out, forms a raised rim round the outer edge. When this is finished, it conceals itself in the hole, keeping only the tips of the forceps, or pincers, above ground; and they are placed wide open, one on each

* Plate XVII.

side. There it patiently remains till some unsuspicious ant, or spider, or even a weaker individual of its own species, happens to mount the raised rim; the loose sand then gives way, and the unwary victim slips in between the formica leo's pincers, by which it is instantly seized and pierced. Nor is it loosened from the grasp till all the juices are sucked out, and that so completely, that the dead carcase may be rubbed to a dry powder between the fingers.

Lucy. But if it catches many, the dead bodies must soon fill up the pit.

Mother. It never allows them to remain there, but with its strong horns throws them out far beyond the surrounding rim.

Lucy. If the ant or spider should not tumble quite in, how then can the formica leo catch it?

Mother. If once the poor traveller ascends the rim its fate is certain; for if it should not fall sufficiently low at first, the formica leo, by means of his flat

head and jointed neck, tosses up the sand in such quantities on the little struggler, as at length to overpower and bring it within reach of his forceps.

Lucy. Are any of these surprising creatures to be found near this, mamma?

Mother. No, my dear, they are not natives of England; but in Germany and Italy, and in the sandy parts of France, they are very common.

After every meal they repair the funnel, and again retire in hopes of fresh victims.

Lucy. Does this treacherous animal continue long in the larva state?

Mother. About two years; during which time it destroys a multitude of small insects: but ants being its favourite food, the neighbourhood of an ant hill is generally chosen for the place of its snare.

Lucy. I do not understand how it can dig a funnel-shaped hole with its pincers.

Mother. First it marks a circle, of the size intended for the outer rim; then, moving round in this circle, it loads its flat head with sand, by means of the fore foot that is next the centre, and expertly jerks the sand over the outside of the rim. When one foot is tired it makes use of the other for its shovel; but in order to form the pit into the shape of a funnel, it is obvious that the sand must be always removed from the inside of the ring in which the animal works: it is for this reason that the foot nearest the centre is employed; and therefore in changing feet it is necessary to move round in the contrary direction. The regularity, however, of the operation is not interrupted by this change of tools. One ring, or trench, is first completed; the next is made by reversing the course of the former; and thus trench after trench, in alternate directions, is thrown out till the whole task is finished.

Lucy. How curious it must be to

watch one of these ingenions creatures! But what does it do if it meets with a little stone?

Mother. It works its body under the stone, if too heavy to jerk out, and having balanced it on its back, slowly moves backwards up the side of the funnel, and deposits it beyond the rim; but should the stone slip off in this attempt, the little creature patiently replaces it; and this it has been known to repeat six times before the attempt succeeded.

Lucy. I wonder how long it is scooping out one of these funnels.

Mother. That must depend on its size and strength, as well as on the dimensions of the funnel; a young myrmeleon is contented with a rim of an inch in diameter, while that of one who is full grown is perhaps six inches across, and the pit deep in proportion. Hunger is a strong incentive to diligence in all animals, and a funnel is sometimes finished in a quarter of an hour, which at other

times would have employed three hours to make. But I must break off this account, which I shall have more leisure to conclude to-morrow.

DIALOGUE XXIV.

FORMICA LEO, OR LION ANT, CONTINUED.

LUCY. I hope, mamma, you will have time to finish your account of the formica leo this morning. I was exceedingly interested by all his contrivances and stratagems that you described.

Mother. It gives me great pleasure that our conversations gratify you so much. I will venture to assert, that as your knowledge increases, so will your enjoyment.

What did I last relate of our little ferocious lion?

Lucy. The manner of constructing his funnel-shaped den, by loading his head with sand, and tossing it out upon

the rim; and then, that the size of the funnel is according to the age and size of the insect; and that the time spent in digging differs just as he happens to be hungry or not.

Mother. Very well; your abridged account is quite right.

This insect, although so voracious as to destroy even its own species, can bear a very long fast. Sometimes it eats so great a quantity as to swell to a bulk and weight that obliges it to remain motionless in the sand at the bottom of the funnel for a great length of time; yet, when it happens that no wandering spider or ant falls into the trap, it seems to bear hunger with extreme patience: this has been ascertained by experiment. A box was filled with dry sand, and so covered with glass that no insect could get in; a lion-ant was placed there; he immediately dug his funnel, took his post, and patiently watched, but watched in vain, for several months.

Lucy. That such a greedy little crea-

ture could have fasted for months does seem surprising.

Mother. When it was taken out of the box it had shrunk to a very small size.

The gentleman, who first observed the manners and habits of this creature, discovered, that it passes the winter months without food; probably it sleeps during the cold weather, like the squirrel and the dormouse. However hungry it may be it never sucks a dead animal, although but that moment killed. The myrmeleon that was kept in the box was often tempted with flies just killed; but they remained untouched, as if it enjoyed the prey only which it had the sport of catching.

When it has attained its full growth, and is about to become a chrysalis, it prepares for the change by burying itself in the sand.

Lucy. I dare say, when beetles meet with it in that state, they soon revenge the many poor creatures it had destroyed.

Mother. It avoids that by enveloping itself in a strong case, where it can securely undergo all its transformations: for this purpose it is provided with a store of fine silk, which, when first spun, is so sticky that small particles of sand adhere to it firmly.

Lucy. I suppose, mamma, in the same way that some caterpillars glue little bits of wood to their case.

Mother. The silky substance produced by different insects seems to be nearly of the same texture; they derive it from a reservoir of a thick, glutinous fluid, which, in the formica leo, is placed near a minute aperture in the abdomen; and as it is forced out through this opening, it acquires the form and tenacity of a very fine silk thread.

By means of a small pointed organ, nicely adapted to the purpose, the thread, in spinning, is stuck to particles of sand, till the outside appears like a ball of sand kept together by a net work of white silk.

Lucy. What a long time it must require to manufacture this curious case!

Mother. It is a creature endowed with much patience and perseverance, and may serve as an example to those, who think nothing worth executing which cannot be at once accomplished.

Having completed this outward sandy shell it proceeds to line the interior with many layers of still finer and softer silk, as shining as satin, and of a pure white.

Lucy. If people were to take the same pains with the lion ant that they do with the silk worm, they might perhaps obtain silk to weave, which would be naturally white.

Mother. It seems possible; but the length of this animal's life would make it a far more tedious and uncertain business than the management of the silk worm, which lives but a short time.

Within this satin nest our larva divests itself of its skin, and becomes a chrysalis; the body much lengthened, and bent round,

so as to suit the size and shape of its habitation. At first the future fly appears very indistinctly formed; but as it approaches the nymph state it gradually acquires more of its perfect shape; till at length, having gained sufficient strength, it breaks out of prison, throws off its silken case, and, expanding its wings, flies away to enjoy the rest of its life in the regions of air.

Lucy. Does it, in the fly state, live longer than the ephemera, which has but two or three hours to enjoy its winged life?

Mother. The length of its life has not been yet ascertained; it certainly lives some days, and probably longer, as it is provided with a mouth, teeth, and a pair of long pincers, which seem as if designed to prey upon insects in its perfect as well as in its larva state; it also feeds on plums and peaches.

Lucy. Are these creatures common in gardens?

Mother. No, they are not very nu-

merous in the fly state; and they produce fewer young than most other insects. The female lays but four or five eggs, each of which she deposits by itself, in such situations as are most likely to afford the larva its proper food. To entrap that food the insect instinctively begins to form its snare the moment it issues from the egg.

Lucy. What sort of fly is it, mamma?

Mother. It is something like the smaller dragon fly. The antennæ are club-shaped, and as long as the thorax—eyes very prominent—mouth armed with jaws, and with two strong teeth—four long palpi, and two slender filaments in the tail, shaped like forceps. The wings are long, much veined and netted, of a dull white, with a few shades, and cloudy spots*.

Lucy. Thank you, mamma, this has been a charming history indeed. But

* Plate XVII.

I have a question to ask you about eyes.

Mother. To-morrow I will answer your question with pleasure, but we must conclude for this day.

DIALOGUE XXV.

THE EYES OF INSECTS. RETICULATED EYES. STEMMATA.

MOTHER. Well, Lucy, what is the question you wished to ask yesterday, about eyes?

Lucy. I want you to explain how insects see; for when I considered what you said of the little projections, in the transparent covering of their eyes, I found that I did not clearly understand it.

Mother. It is a difficult subject to explain to a little girl, who does not yet know any thing of the construction of a common eye. Very few insects have the power of moving their eyes, and none of them in the same degree or manner that we do; for instance, we can turn our eyes from one object to another, with the

quickness of thought, and either sideways, or up and down; and thus we are saved the continual trouble of turning the head. We are also furnished with eyelids, by closing which, we protect those tender organs from dust, from injuries, and from too strong a glare of light; and these eyelids are fringed with short hairs, which, in some measure, answer the same purposes, while the lids remain open; but no insects have eyelids.

Lucy. Then, I should think, that their eyes must often be hurt by the clay and stones, which they unavoidably meet with under ground.

Mother. For that reason the outer coat or covering of their eyes is very hard, resembling horn in strength, but as transparent as glass.

Lucy. You said, that the little projections enabled the animal to see in every direction, as well as if it could move its eyes?

Mother. Feel this magnifying glass.

Lucy. It is thicker in the middle, than near the edge.

Mother. Any surface, that gradually rises from the edge towards the centre, is termed *convex :* a glass of this form is called a *convex lens,* and it magnifies more or less, in proportion to its convexity.

Lucy. That is, its greater or less thickness in the middle, is it not ?

Mother. Precisely. By means of microscopes, or lenses, which magnify considerably, it has been discovered, that the eye of a dragon fly, and of most other insects, is composed of a number of very small convex lenses, which are so combined as to form, in appearance, one single projecting hemisphere. Do you remember the meaning of that word ?

Lucy. Oh yes, I do ; a sphere is a globe, and hemisphere is a half globe.

Mother. Now each of these very small lenses separately transmits whatever object is directly opposite to it, and

therefore, whether that object be above, or below, or at one side, provided it be within the limits of the whole hemispherical projection, some one lens will be found in the proper situation to convey its image to the interior of the eye.

The eyes, which are composed of a number of these lenses, are termed *reticulated,* because they bear a resemblance to the meshes of a very fine net.

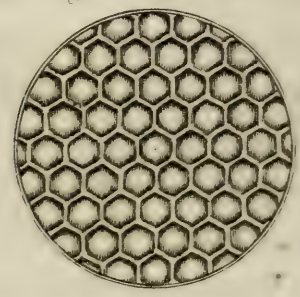
Lucy. Just as if little round lenses were stuck into every mesh of the net.

Mother. Not exactly: two circles, you know, can only touch each other in a single point; and if the lenses were round, there would consequently be a considerable space lost between each of them. The most common shape is hexagonal, or six-sided; figures of this form fit close together, as you may observe in the cells of a honeycomb.

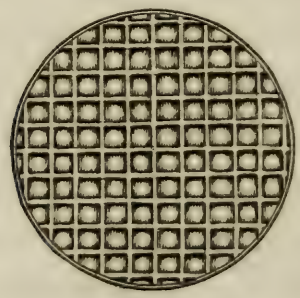
I have made a drawing of a part of the eye of a dragon fly*; but it is greatly

* Plate XVIII.

Plumes or scales of the Moths wing greatly magnified.



A small portion of the Eye of a Dragon fly much magnified.



Part of a Lobster's Eye magnified.

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magnified, in order that you may distinctly see the arrangement of the lenses.

Lucy. I see indeed, that every lens has six little sides, and that there is no space lost between them.

Mother. Here is another drawing—part of a lobster's eye, which is also magnified: in this you may perceive that every lens is square.

Lucy. I was astonished when you mentioned the six lenses of the formica leo, but there is such a number in this drawing of the dragon fly's eye, that I can scarcely reckon them.

Mother. You may spare yourself the trouble, for it represents but a very small portion of the whole surface; it is even said, that each eye of the libellula grandis, or large dragon fly, contains twelve thousand separate lenses.

Lucy. Oh dear, mamma, one can hardly imagine that such an amazing number could be contained in so small a space. Has any other insect so great a multitude of lenses?

Mother. The moth of the silk worm is supposed to have six thousand lenses, that is, three thousand in each eye; in a butterfly, they are estimated at seventeen thousand; and in the eye of a small fly, eight hundred have been actually counted by Leuwenhoek, a celebrated naturalist, who lived in the beginning of the last century.

Lucy. How was it discovered, that each of these different lenses was a distinct eye?

Mother. That indefatigable philosopher contrived, by using a microscope, to look through one of them.

Lucy. And could he see any thing?

Mother. He distinctly saw the steeple of a church, which was seven hundred and fifty feet from the place where he sat. In looking also at the front of a house, he could distinguish the windows and doors, and could discern which of the windows were open. Thus, each lens may be considered as the *object glass* of a tiny telescope.

Lucy. How wonderful! Of all the delightful things you have told me, not one is so curious as this!

Mother. I have yet another wonderful circumstance for you: many insects have other organs of sight besides their reticulated eyes.

Lucy. More eyes! Where can they be placed?

Mother. Generally above the others, that is, more towards the top of the head; they are like shining raised points or specks; and each contains a single eye.

Lucy. Of what use can they be, to animals that have so many others?

Mother. These eyes are called *stemmata,* and are of material use in watching any enemies which may be above, and rather behind. They are also probably adapted to a wider extent of view, and are therefore supposed to assist in guiding the flight of those insects who possess them. When the three stemmata of a bee were covered with pitch, by a person who tried the experiment, it flew at

random, and seemed incapable of directing its course towards the hive. When only the reticulated eyes were covered, the bee flew directly upwards without hesitation, and disappeared. But, when both the reticulated eyes and the stemmata were covered, the poor insect was evidently quite blind, walked badly, and did not venture to fly.

Lucy. The poor things! I am sure I will never try such cruel experiments.

Mother. I hope not—it is quite sufficient, that others have tried them for us.

Now, my love, do you understand the general description that I have endeavoured to give you?

Lucy. I believe I do pretty well; and I am very much obliged to you for being so patient as to answer all my questions.

DIALOGUE XXVI.

FIFTH ORDER, HYMENOPTERA. MEANS OF DEFENCE. STINGS.

MOTHER. We have now gone through four of the orders; and I think you are sufficiently interested with the study of Entomology to persevere a little farther, and perhaps to pursue it in future.

Lucy. Indeed I am sure that I shall never find any other half so amusing.

Mother. So you think now, because its novelty engages your attention; but you will hereafter find, that many other objects will equally excite your enthusiasm. Do not imagine, that I wish to confine your industry to this branch of knowledge; there are other, and far more im-

portant subjects, to which, I trust, this will be a useful preparation. A general idea of natural history enlarges and fortifies the mind; it teaches us how to observe the wonderful economy of nature, and materially assists our reasoning faculties.

I was therefore happy to take advantage of your casual discovery of the little moth, when emerging from its chrysalis case, to lead you at once into this department of natural history; and in addition to the rational amusement it has afforded, it will secure you from the foolish fears and prejudices, respecting insects, which torment so many people.

Lucy. No, mamma, I cannot, now, be so childish as to be afraid of a poor caterpillar; or even of a Harry-Longlegs, as Miss W—— was the other day.

Mother. Fears of that kind arise from ignorance; she did not know, that these creatures have neither the inclination nor the power to hurt us.

Lucy. But, mamma, only think of my cousin Louisa's saying last night, that she thought all the accounts of insects must be fudge.

Mother. Your cousin Louisa is clever, and has read a great deal, for a girl of fourteen; but in such a desultory manner, that she has reaped but little advantage from what she has learned. Superficial knowledge usually produces vanity, and self-sufficiency; the former makes us too well satisfied with our own pursuits, and the latter prompts us to undervalue the pursuits of others: but, my dear, we will not scan your cousin's faults too closely; I have no doubt, that, as she grows older, she will cure herself of these defects. Endeavour to profit by the faults you perceive in others, and to take the warning their example affords.

Now let us proceed with our own affairs. The fifth order is called *hymenoptera.*

Lucy. I think the names of all the classes end in ptera.

Mother. They do. You know that *ptera* signifies wings; and that by their substance, numbers, or situation, the several orders are distinguished.

Lucy. Yes, mamma, I recollect the meaning of the names of the four first orders. What does hymenoptera mean?

Mother. *Hymen* signifies a membrane, and the order *hymenoptera* comprises all those insects, which have four membranaceous wings, such, for example, as belong to the bee.

Lucy. But the insects in the order neuroptera have four wings, and very like those of the bee.

Mother. There is some resemblance, but they are much more transparent, and more like net work: whereas the wings of bees are ribbed chiefly lengthwise, and are much less transparent than those of any of the neuropterous insects. In some of the genera, however, the male fly has no wings; in others, the female wants them; and in some, the *neuters* have none.

Lucy. What are neuters? You never spoke of them before.

Mother. Because they appear to be peculiar to this order. The *neuters* are insects, which, as far as naturalists have yet discovered, are neither male nor female: they seem to be intended merely for labour, as you will see when you become better acquainted with bees and ants.

The bodies of flies belonging to this order are much shorter and thicker than in the order neuroptera, and both the females and the neuters are armed with stings.

Lucy. I think you said that none of the flies in neuroptera could sting?

Mother. True; none of them are provided with stings: but some species have strong jaws, with which they can pinch, though they seldom make that use of them, unless in self defence.

Lucy. Have the flies of hymenoptera jaws as well as stings?

Mother. Yes, but they only employ their jaws in building their nests, and in

providing for their young; their stings are their only weapons, and these they sometimes use not only in defence, but in attack, though very seldom, unless provoked.

Lucy. I thought that wasps often stung, when no one had a thought of hurting them?

Mother. I have known them sting, when I could perceive no cause for their irritation; but as both bees and wasps are supposed to dislike certain smells, it might have happened that the person stung had been obnoxious in that way. When we consider the prodigious number of insects, possessed of the power of stinging, which are continually flying around us during the whole summer, and recollect how seldom we hear of any person being stung, we must acknowledge that their aggressions are very rarely wanton.

Lucy. Indeed! mamma, that is very true; and it will, I hope, entirely cure me of my silly fears; but there are such

shocking quantities of them about the gooseberry bushes!

Mother. Yet none of us have been stung. If you do not molest them, they will hardly quit their more agreeable occupation of collecting honey, to make war on you.

DIALOGUE XXVII.

TENTHREDO, OR SAW-FLY. T. CAPREÆ. VITELLINÆ. T. ROSÆ. FALSE CATERPILLARS.

MOTHER. What subject are we to have for this morning's conversation, Lucy?

Lucy. The flies that belong to the order hymenoptera.

Mother. We shall begin then with the *saw fly*, or *tenthredo.*

Lucy. Why is it called saw fly?

Mother. Because it is furnished with a minute saw, with which it makes an incision in the bark of trees, and there deposits its eggs.

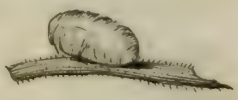
Lucy. What trees do they live upon?

Mother. On pear trees, willows, sal-

Tenthredo Vitellinae?

Tenthredo Rosea
Rose Saw fly.

The Larva.



The Pupa.

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lows, rose trees, and gooseberry bushes, and on several others, as you may well imagine when I tell you, that one hundred and fifty species belong to this genus.

Lucy. Is it a small insect?

Mother. Some are very small, but the most common species, with which I am acquainted, the *tenthredo capreæ,* is about the size of a small house fly, and may be often found in windows. The largest kind that I have seen is the *tenthredo vitellinæ* * ; it is as large as a middling sized humble bee.

Lucy. And, mamma, have they all little saws?

Mother. Before I answer your question I will give you the general description of the whole genus: wings tumid, or of a bulky consistence—jaws, but no proboscis—antennæ different in the various species—abdomen of equal thickness, and closely united to the thorax—stings serrated, and placed between two valves.

* Plate XIX.

Lucy. A toothed sting would give a terrible hurt.

Mother. They very seldom attempt to use their saws for stinging; each of them have in fact two saws, placed so close together as to appear only one, unless examined through a microscope, and observed at the time the fly is at work.

Lucy. How does it use them?

Mother. While one saw is thrust forward the other is drawn back, and by this alternate movement double work is performed.

Lucy. Like the two dashes in the double pump churn, one up, and the other down.

Mother. That is, they move alternately, or one after the other in constant succession.

One species of these flies does a vast deal of mischief in spring, when the fruit is setting; it pierces a little hole with its saw, and drops its diminutive egg into the new formed fruit, which a tiny caterpillar, quickly issuing from the egg, begins to

devour. By the time that the caterpillar is ready to change to a chrysalis, the sickly fruit falls from the stalk; the little animal then creeps into the ground, and after spinning for itself a case of coarse net-work, which it lines with a close, soft web, becomes a chrysalis, from which afterwards proceeds a saw fly.

Lucy. What a quantity of mischief these little creatures must do! You said, they were found upon rose trees; do many of them eat our dear roses?

Mother. Several kinds, I believe. There is one, which makes seven or eight small wounds in a young shoot, and in each wound places a single egg; as the larvæ increase in size the shoot becomes unhealthy, and the flower, deprived of its due nourishment, withers in the bud.

Lucy. I frequently observe little rose buds, that look as if they had been dried up; I suppose this is the work of those vile saw flies?

Mother. There is another species, the *tenthredo rosæ,* whose ravages are

still more provoking; the fly deposits an egg in the flower bud, which, for a while, continues to flourish; but when the caterpillar has eaten down to where the bud joins the stalk, it begins to fade; if the flower blows, it has a sickly hue; the supply of nourishment is interrupted, and as the mischief increases it droops to one side, and dies.

Lucy. Indeed, mamma, upon my own moss rose tree there are some flowers in the way you describe; but the gardener told me it was a blast.

Mother. Yes; a blast is the common cause to which every misfortune of this kind is ascribed; but the blast is often wrongfully accused of injuries, that are commited by various tribes of insects.

The larvæ of this genus have in general a greater number of legs than those of moths and butterflies, and have thence been called *false caterpillars*, a name, by which you will often find them mentioned in books.

Lucy. Are they not real caterpillars?

Mother. Yes; but those termed *true* caterpillars, you know, have seldom more than six legs; whereas, these possess from six to twelve others. The additional legs, which are attached to the hinder segments of the body, are called *spurious;* or by some authors, from their peculiar structure, *membranaceous* legs. They seem to be of little use to the animal in walking, but it steadies itself by them in feeeding; and, as they are furnished with a beautiful apparatus of minute claws, or hooks, they are of material service to it in clinging, or climbing.

The *tenthredo vitellinæ,* which I have painted in my book of insects, I found, in the caterpillar state, in the rotten wood of a hollow hawthorn tree; it was rough like shagreen, of a dusky blueish colour, and its head was large, and of a dull red. I kept it in a box for some days, during which it did not eat the rotten wood, with which I supplied it. It then spun a thick case, to which it glued a quantity of little scraps of wood, and

in about three weeks the fly emerged from its case.

Lucy. Where is your book of drawings, mamma?

Mother. In my table drawer; and very much at your service, as I know you will be very careful of it.

Lucy. Thank you, mamma; now good bye for a long time, as I am going to search the bushes and leaves for more insects.

DIALOGUE XXVIII.

ICHNEUMON FLY.

MOTHER. Had you much success in your search for insects yesterday, Lucy?

Lucy. Not as much, mamma, as I expected; but I did find some caterpillars; I have them in boxes, and I intend to feed them carefully with the kind of leaves, on which I found them.

Mother. You should write on a narrow slip of paper a memorandum of the day when you found them, and the tree on which they fed; with a short description of each, and paste this paper on the outside of the box. By these means you will acquire an accurate knowledge of the caterpillar, of the trees to which they are injurious, of the time they re-

main in the pupa state, and of the imago, or perfect fly, which is produced from each caterpillar.

Lucy. Thank you, mamma, I will carefully do so; for, if the flies should not come out till next spring, I might forget which was which, or what plants they had lived on.

Mother. Now then we may turn our attention to the history of the *ichneumon fly.*

Lucy. What does that odd name mean?

Mother. Ichneumon is the name of a little fourfooted animal, which is found in many of the warm climates, but chiefly in Egypt. Can you tell me where Egypt is?

Lucy. Yes, mamma; Egypt is in Africa, on the coast of the Mediterranean sea, and the Nile runs through it.

Mother. Very well. The river Nile is much infested with crocodiles, large amphibious creatures, which devour every sort of animal, that comes in their way.

The crocodile lays its eggs in the sand; these eggs are the favourite food of the ichneumon, who roots them up, and sucks out the inside through a hole, which it breaks in the end of the egg by rolling it against a stone. The ichneumon destroys numbers of young crocodiles also, after they have left the egg, and before they reach the water. It preys besides upon serpents, rats, mice, and poultry.

Lucy. It seems to eat every thing it can catch; but I thought the ichneumon was a fly?

Mother. The ichneumon fly is named after that animal.

Lucy. Are the flies as great devourers, since they have the same name?

Mother. Just so; it was given to them because they perform a similar service in destroying caterpillars, and a number of other insects. The ichneumon fly is of a very peculiar shape: the abdomen is joined to the body by a slender stalk, and this is a distinguishing mark of the

whole genus of ichneumons, whether large or small.

Lucy. Are there a great many species?

Mother. A vast number; more than five hundred have been enumerated and described. Some of these are an inch and a half long, while other species do not measure quite one eighth of an inch in length.

Lucy. Can such little creatures devour others?

Mother. The larvæ are the chief devourers. The flies are furnished with a sting, which is most curiously contrived: it is composed of three pieces; two of these form a kind of sheath, which contains the sting itself. The sting is toothed along the edges, but in the middle there is a small channel, or hollow groove, in which the eggs roll, and are thus guided to the spot where the fly wishes to place them. Several sorts of the ichneumon lay their eggs in the

bodies of caterpillars by means of this sharp instrument, which they support with their two hind feet lest it should break. They bore a hole through the skin of the caterpillar and drop into it an egg; for every egg making a fresh incision. The large flies put only two or three eggs into the unfortunate caterpillar, but the small ichneumons insert from ten to twenty.

Lucy. What pain the poor caterpillar must suffer; but I suppose it soon dies?

Mother. While the ichneumon is in the act of inflicting these wounds, and depositing its eggs, the caterpillar writhes about, and seems to be in great agony; but it soon recovers, and generally lives the usual length of time, without apparent suffering; sometimes it even increases in size, and regularly changes its skin. But when the time comes for changing to the chrysalis state, the ichneumon larvæ eat their way through the caterpillar's skin, and spinning little silken cocoons become

chrysalids, leaving the caterpillar an empty skin.

Lucy. Poor miserable caterpillars! so these little ichneumons eat out the inside of the poor creature in which they live?

Mother. They do not destroy the vital parts, but are contented with sucking out the nutritious juices, which the caterpillar derives from its food: sometimes the caterpillar has sufficient strength to change into a chrysalis, but the fly never perfects its shape, nor attains its proper size, having been deprived of its nourishment by these internal enemies. Some ichneumons lay their eggs in spiders' bags; others pierce through the hard substance, like mortar, of which the outside of a wasp's nest is formed, and place their eggs near the cell, where the egg or the larva of the wasp is lodged; to this the young ichneumon soon penetrates. Some of the small ichneumons insert their eggs into the eggs of moths and butterflies; and when the

little caterpillars might be expected to appear, tiny maggots come forth and immediately spin their cases. One species place their eggs in the bodies of the *aphis*, or *plant louse*.

Lucy. The plant louse! Are not those the little grubs of different colours, which collect in such crowds on the shoots of honeysuckles and roses?

Mother. Yes; the *aphides* are most mischievous grubs, which multiply to an astonishing degree. The ichneumons do us great service by destroying them, as they injure plants very much.

Lucy. They seem to destroy all insects whatever, that are weaker than themselves.

Mother. They may be compared to the carnivorous tribes of animals, among beasts and birds.

Lucy. What does carnivorous mean, mamma?

Mother. Carnivorous animals are those that eat flesh; the large ichneu-

mon flies feed very much upon spiders, on which they pounce as the hawk does on its prey.

Lucy. Old and young, flying and creeping, I see they are always carnivorous.

Mother. As far as their habits of life have been investigated, I believe they are.

We will now see how the genus is characterised. Antennæ of more than thirty joints, long, filiform, and always vibrating—sting within a bivalve sheath—mouth armed with jaws, no tongue—abdomen joined to the body by a pedicle, or stalk.

Lucy. I wish, mamma, I could find a caterpillar with some of these little larvæ feeding in it.

Mother. If you collect a number of the common cabbage caterpillars you will be very likely to find one or more among them loaded with these inward devourers.

DIALOGUE XXIX.

SPHEX, OR ICHNEUMON WASP.

MOTHER. The insect, which I have chosen for the subject of to-day's conversation, is called *sphex;* it is also called the *ichneumon wasp,* because it bears a strong resemblance to both those insects.

Lucy. Is it as fierce as the cruel ichneumon?

Mother. It is so fierce as to have obtained the name of savage. Both the larva and the fly feed upon other insects; the larva upon dead caterpillars; the fly upon large spiders, fifty of which scarcely suffice it for one meal, as it eats only the contents of the head, and a very small part of the body. The remains of these

mangled creatures, strewed round the outside of its den, betray the abode of this little savage.

Lucy. And are there many species of these horrible creatures?

Mother. Upwards of a hundred are to be found in various parts of the world, but only a few of them are natives of these islands.

Lucy. I am sure I rejoice at that, however useful they may be.

Mother. The *sphex spirifex* digs a hole in the ground for her eggs, and constructs there a set of cells, in a very curious manner. As she digs out the sand she kneads it into a paste, with a glutinous liquid proceeding from her mouth; of this paste she makes little round balls, by means of her teeth and fore feet, and places them in circular rows one over the other. Between the balls many openings are left, so that the structure forms a sort of coarse filigree, or open work tower round the mouth of her burrow.

Lucy. How high is this filigree tower?

Mother. Sometimes three inches: but the height depends on the dimensions of the hole. The sphex works with such industry, that in a very few hours she makes an excavation of nearly three inches in depth, and raises a tower of equal height.

Lucy. And does she live inside of this tower?

Mother. As soon as the hole is made the sphex lays an egg at the bottom. She then seizes on a caterpillar, which, though much larger than herself, she drags to the nest, and places it over the egg: on the caterpillar she rolls down one of the uppermost balls, and, scraping some sand upon it with her feet, she fills up all the chinks. She often goes down into the hole, and seems as if she was beating the bottom smooth with her feet. A second egg is afterwards placed, and provided with food in the same manner as the first. Thus she deposits

all her eggs, to the number of ten or twelve; and when every thing is completed she smooths and dresses the ground, so that no trace of her ingenious nursery can be discovered.

Lucy. This is a most curious account indeed: but when the larvæ, that come from the eggs, have eaten up their food, what becomes of them, how do they get out?

Mother. They are then of the proper age for their transformation to take place, and, after a few days of abstinence, each of them spins a cocoon, in which they become nymphs. In this state they remain but a short time, and come forth from their earthy nest perfect *spheges.*

Lucy. Poor wretched caterpillars, to be shut up in such a prison, and gradually eaten away!

Mother. One of the most singular circumstances in this process is, that the sphex always chooses full grown caterpillars; just at that period when they would naturally leave off eating, prepa-

ratory to their change into chrysalids. The caterpillars, therefore, require no farther food, and live long enough for the consumption of the young larvæ of the sphex when hatched. Should the provident sphex not find caterpillars large enough to answer singly for the provision of each cell, she takes two of a smaller size, or even three.

Lucy. What a variety of enemies the poor caterpillars have.

Mother. They have indeed a vast number. There is said to be a species of sphex in the Isle of France, that makes a nest as large as that of the swallow, and fixed much in the same manner to a wall; each nest contains several cells, and each cell one egg, with a store of three or four spiders.

The Isle of France produces another beautiful sphex, which is much regarded by the inhabitants for the havoc it makes among the cock-roaches, that infest that country.

Lucy. They must be of very great

size to catch such a large, strong creature as a cock-roach.

Mother. They are large, and so courageous, that they will attack insects three times their own size. This kind of sphex changes its hue from blue to green, according to the light in which it is seen. When it spies an unfortunate cock-roach, it halts in front of the enemy: the two insects seem to pause a few moments, as if examining each other; the sphex then darts upon his victim, skilfully seizes it by the head, and, bending his tail under its body, stings it in the abdomen. The sphex then quits his hold, and walks about for a time, certain that his prey cannot escape; when it returns to the motionless cock-roach, he takes it by the head, and, dragging it backward to his den, eats it at leisure.

Lucy. I wonder the inhabitants are not afraid of flies, that have such terrible stings.

Mother. Very probably they may be somewhat afraid of them, but, aware of

their utility, they are too wise to molest them.

The genus sphex is thus described: antennæ of ten to sixteen joints, always vibrating—upper lip horny—no tongue—palpi four—jaws strong, crooked, and dentated, or toothed—wings expanded horizontally over the abdomen—sting sharp, and concealed in the abdomen. There are several other species of this genus, which are equally curious in their modes of life; however, they all agree in the characteristics of ferocity, and of astonishing strength, in proportion to their size.

Lucy. And, mamma, will you not give me some farther account of those other species?

Mother. Not at present, my dear; hereafter you may read more detailed accounts than can be given in conversation. To-morrow, I mean to present you with a little of the surprising mass of information, which naturalists have collected concerning wasps and bees.

DIALOGUE XXX.

VESPA, OR WASP. V. CRABRO, OR HORNET. V. VULGARIS, OR COMMON WASP.

LUCY. This morning, mamma, we are to have bees and wasps.

Mother. The *wasp,* or *vespa* genus, comes first in order; there are above two hundred and twenty species in it, but very few of them are to be found in England. The largest, with which we are acquainted, the *vespa crabro,* or *hornet,* is armed with a strong sting, with which it can inflict a very painful wound, that inflames, and continues to be troublesome for some days. The hornet is voracious: it kills and preys upon many sorts of insects; and even destroys large bees, in order to rob them of their honey-bags. It generally builds its nests in hollow

trees, where it is secure from rain; and sometimes chooses for that purpose the timbers of old lofts, or out houses. The shape of its nest, and the colour of the outer covering, have very much the appearance of a large brown cake. The nest is composed of the dust rasped off decayed timber with its jaws, and made into a strong paste, with a liquid, like glue, which the hornet emits from its mouth. Of this paste, which when dry resembles brown parchment, it forms a coarse comb, something similar to the honeycomb, but divided into very large cells, suitable to the size of the hornet, which is full an inch in length.

Lucy. It is very fortunate, that the hornet is not as common as the wasp, for they would destroy all our bees.

Mother. The hornet, as it flies, makes a very loud humming noise, which warns insects of the enemy's approach, and, as its flight is slow and heavy, gives them time to make their escape.

Lucy. The common wasp, I suppose,

eats only fruit, as we see such crowds of them round every fruit tree?

Mother. The *vespa vulgaris,* or common wasp, is not only fond of fruit, and of every thing sweet, but of meat, and of insects too. Most of the wasps perish in the cold during winter, only a few queens, or females, escaping to produce a nation of wasps the following summer. The queen, or female wasp, if she cannot find a convenient hole in the ground, makes one, providing it with a winding passage, by which to go in and out; and in this hole she constructs about twenty cells, and lays as many eggs.

Lucy. Only twenty! a great many queens then must outlive the cold, to produce such quantities of wasps as are to be seen every summer.

Mother. She lays many more than twenty eggs; but she begins by producing only that number; and within three weeks, they pass through the stages of larva and nymph, and come forth perfect wasps. By a wise provision of

nature, these are all working wasps, neither male nor female; as soon as they fly, they fall to work in the service of the queen mother, whom they assist by enlarging the cavern, and building numerous cells. They procure the materials by biting and tearing small particles of wood from posts, window frames, and door cases; glueing them together on the spot, and then carrying them home. The labourers, that remained at the nest, relieve them of their burdens, and they all join in working up the wood with the liquid which they disgorge, till it forms a white paste. Of this substance they form the cells, and erect over them three or four roofs, or coverings, at a small distance above each other, by which means all damp is completely excluded.

Lucy. It would be delightful to watch the wasps, while at work; but that would be rather dangerous.

Mother. If under a glass hive, it might be done with safety. There are several tiers or stories of cells, with passages between them; and each tier is

supported by numerous pillars. When the cells are completed, the queen lays an egg in each, to the number of fifteen, or even twenty thousand; and all these produce neuters, or labourers. While larvæ they are fed by the elder wasps, first with the juices of fruit, which they distribute from their own mouths into those of the young worms, and as the larvæ gain strength, with the dead bodies of insects. As soon as this generation become wasps, they likewise labour at the nest, and are employed in feeding the larvæ of the next brood. Having provided a sufficient number of labourers, the queen begins about the end of July to lay eggs, which produce male and female wasps; the males have their appointed work, which is to clean out the nest, and to clear away the fragments of their meals, which consist of the honey-bags of bees, dead insects, and scraps of meat, particularly of veal, and all of which had been brought home to the cells by the workers, and impartially divided amongst the whole community.

Lucy. What robbers and murderers they are!

Mother. Yes, they plunder the poor butchers; but, however, they are of great use to them.

Lucy. Of use! how can that be?

Mother. The wasp is a mortal enemy to the blue fly, which never ventures into a butcher's stall, when frequented by wasps. In France it is a common custom among butchers to hang at the door of the shop a veal's liver, which being much sought after by the wasps, attracts them in such numbers as to deter the blue flies from approaching.

Lucy. Well, that is a comical plan, to drive away one set of tormentors by encouraging another.

Though wasps are so ferocious abroad mamma, they seem to live very happily at home.

Mother. They continue to live in harmony till the end of September, when the cold begins to affect them, and most kinds of provisions grow scarce. The nest then

becomes a scene of confusion, the neuters, or labouring wasps, join with the males to drag all the eggs, worms, and nymphs, out of the cells, and to destroy them; after this they fight together; many are killed; the remainder are destroyed by the cold weather, and a few females only escape, by creeping into sheltered nooks, where they continue in a state of torpidity, or sleep, till revived by the warmth of spring.

Lucy. If it were not for this war, by which such thousands are killed, we should be overrun with wasps. I suppose, mamma, that the labourers murder the young ones, to save themselves the trouble of providing food for them, which it would be so difficult to find?

Mother. There is a small species of wasp in South America, which builds its nest of a substance resembling the finest paper. The nest is something like a box, and is suspended to the branch of a tree.

Lucy. How pretty the little white

nests must look. Could no use be made of the paper?

Mother. I have never heard of any experiments having been made for that purpose: but it has been observed, that, possibly, the example of the wasp might be advantageously followed, and that we might manufacture paper from wood. In proof of which the Chinese paper is made of the bark of the bamboo.

Lucy. I wonder, mamma, that no one has tried whether it could be done.

Mother. I have seen very tolerable paper made of straw; but straw is so much used as litter and provender for cattle, and in some parts of the country for thatching houses, that probably this paper would not be cheaper, than that which is made of rags.

Lucy. I should like very much to know how paper is made from rags.

Mother. Ask papa this evening, and I am sure he will with pleasure explain to you the whole process.

Lucy. I will certainly ask him. Now,

mamma, you said the bees were to follow the wasps.

Mother. But have we not had as much of the wasps as you can well remember? I think we had better defer the bees till to-morrow, and finish this day's conversation by the general description of the vespa; it is thus: mouth armed with jaws—no tongue—body smooth—sting concealed—antennæ long—wings folded lengthwise.

Lucy. Thank you, mamma, good bye.

Mother. Before we part, I must mention two particularities which distinguish this whole genus: one is, that the upper wings are folded in two, the whole of their length, whenever the animal is not flying; the other is, that where the wings are jointed to the body, there is a sort of scaly projection placed over them; this projection acts as a sort of stay, and prevents the wings from being stretched too far, or from being flapped too violently; this is a most useful provision for such in-

sects as are often obliged to pursue their prey on the full stretch of their wings.

Lucy. The other carnivorous flies, whose history you have told me, seem to take their prey by cunning and contrivance; but wasps are hunters, and catch it by the chase, as dogs do hares and foxes.

Mother. Thus you see how well the structure of these little creatures is adapted to provide for their wants; and how admirably they are enabled to fulfil the several parts assigned them in the creation.

DIALOGUE XXXI.

APIS, OR BEE. A. MELLIFICA, OR HONEY BEE.

LUCY. This morning, mamma, you appointed for the history of the bee, which I am sure I shall find even more amusing than that of the wasp.

Mother. The accounts of all the species of bee are most curious; and it is surprising that naturalists have been able to discover so much of their manners and way of life, when we consider the difficulty of closely observing an insect, which is so irritable when disturbed, and so very apt to use its sharp sting. Whole volumes have been written on the honey bee alone; but I will try to give you a short and clear account of it.

Lucy. Thank you, mamma; you are very good to me.

Mother. The genus of *apis*, or *bee*, comprises a great number of species, and of almost every species there is something curious to be observed; but the *honey bee*, or *apis mellifica**, is not only the most useful to man, but the most remarkable in its economy. Of this family several varieties have been found in different parts of the world: they all produce both honey and wax, though none seem to make them of as good a quality as the domestic honey bee, which is so common in this country.

Lucy. Our bees all live in hives; how do they live when they are wild?

Mother. They construct their combs in hollow trees, in chimnies that are not used, or the chinks in old walls; in short, in any secure hollow place. Vast quantities of bees live in the forests of Poland, where they build in the large

* *Mel*, honey; *mellifica*, honey-maker.

trees. Though wild, they are yet protected by the laws of the country; and people, who rob the nests, or disturb the bees, except at the proper and established time of year, are severely punished.

With regard to the economy of the domestic bee: when a swarm quits the old hive, it is composed of one queen bee, of some hundreds of male or drone bees, which have no stings, and of several thousands of working bees. If the queen be taken from among them, the swarm falls into confusion, and seems not to know how to proceed when deprived of its leader. But if another queen be given to them they regain their composure, and tranquilly follow her wherever she flies.

Lucy. But how can people take the queens? Are not they stung by them?

Mother. The queens have stings, but they very seldom make use of them, and may be handled, if it be gently done, with great safety.

As soon as the bees are lodged in a

new hive they divide themselves into four parties, one of which rove the fields in search of materials; another company, after running up and down the hive, and stopping every little crevice through which air could penetrate, begin to lay the foundation of the cells; a third set of workers polish up and finish all that the others have begun; and the fourth party bring home food to those that have been labouring in the hive.

Lucy. But how can they carry food? Do not bees live on honey?

Mother. Bees are provided with two stomachs; in one they carry the purest honey, which they suck from flowers with their trunks, and which is to be stored up in the cells; and into the other stomach they put the farina of flowers, and the honey necessary for their food.

Lucy. What is farina?

Mother. In the inside of flowers you may recollect to have seen some yellow or orange-coloured powder; this dust is called *farina.*

Lucy. But do the bees carry the farina home in their stomachs?

Mother. No; when a bee alights in a flower, it rolls and rubs itself about, till, by means of the hairs with which it is thickly covered, it has collected all the farina; then, by passing its legs over its body, it brushes off this dust, and forming it into pellets, sticks them into a cavity, or hollow, in each hind thigh. When a bee, thus loaded, returns home, it is immediately surrounded by some of the stay-at-home workers, and into each of their expecting mouths it pours through its trunk a little honey. The newly arrived bee is also unburdened of its farina, which is either eaten by the other bees, if hungry, or placed in proper cells, where it is known by the name of bee-bread.

Lucy. What a very disagreeable taste it has.

Mother. In three days these industrious little creatures have been known to make comb enough to contain three thousand eggs.

Lucy. I suppose, like the wasps, they put only one egg in each cell. Do they feed the maggots in the same way?

Mother. Just so: the working bees take the greatest care of the worms, constantly supplying them with food till the time for changing to a chrysalis arrives. Then they close over the top of the cell with a thin coat of wax; and the little worm proceeds to spin a delicate web, in which it becomes a nymph. In this state it continues for a few days, when it quits its case; and, eating its way through the thin roof of its chamber, makes its appearance as a winged bee.

Lucy. How long is it becoming a perfect bee?

Mother. About twenty days from the time the egg was laid. When a young bee comes forth, some of the elders surround it and give it honey from their trunks; its strength thus confirmed, away it flies, and collects honey with as much skill as the oldest in the hive. The labourers then throw from the hive the

nymph skin and case, and clean out the inside of the cell, in which the queen immediately places another egg. In this manner one cell answers for four or five successive worms.

Lucy. What immense quantities of bees there must be in a hive!

Mother. Sometimes forty thousand: but when they become too numerous for the hive to contain them comfortably, a separation takes place, and a large proportion flies off to form a new establishment elsewhere. The new colony, or swarm, immediately begins to work, and spends the whole summer, and all the fine part of the autumn, in building the combs, rearing the young, and laying up the winter's provision. When the weather begins to grow cold, the working bees, as if anxious to diminish the number to be fed during the winter, destroy all the drones, either by stinging and worrying them to death, or by driving them out into the cold, which speedily puts an end to them.

Lucy. Does not cold weather sometimes kill whole hives of bees, mamma?

Mother. Very severe cold does; for which reason some people keep their hives in cellars, or in bee houses; however, in general, they live through the winter very well, especially if the hive be plastered round the bottom, as a defence against both cold and vermin; but a little door must be left, just large enough to let a bee walk out, which they often do on fine days. It is useful to put a cap of straw over each hive, to throw off the rain and snow; and the bees ought also to be fed now and then, in order to prevent them from consuming all their own stores, as in that case they would deprive themselves of food in the beginning of summer, before they were able to collect a fresh supply.

Lucy. How can they be fed? Can you give them honey?

Mother. Honey is not thought to be the best food; some people give them soft

sugar; but what succeeds best is wheat, boiled in sugar and water; this is very nourishing, and does not injure the bees by sticking to their hairy bodies.

Lucy. You said, mamma, that the queens have stings, but that they seldom use them: have all the other bees stings?

Mother. The drone, or male bees, have no stings, and are therefore quite harmless; and though the working bees are armed with stings, they do not often exert them without provocation. Most people give way to very unfounded fears both of wasps and bees, but particularly of the latter, which, except at swarming time, never sting, unless greatly irritated.

Lucy. Is it true that the bee always leaves its sting in the wound?

Mother. The sting of the bee is most beautifully contrived. Within a strong sheath are placed two small stings, which resemble an arrow, divided along the middle; that is, the two sides which

touch each other are smooth, while the outer edge of each is barbed, like a dart or arrow.

Lucy. Yes, mamma, I know the shape of an arrow. I understand the bee can easily push the sting in, but cannot pull it back.

Mother. These two stings move alternately; the first that is forced in, catches the flesh by its barbed point; the second sting is then pressed forwards beyond the first, and, hooking the flesh, keeps a firm hold, till the first sting has again passed it, and, entering still farther, has caught a deeper hold: in this alternate manner they move, till the whole sting is buried in the flesh, to its full length. The bee then discharges into the wound a drop of liquid from a little bag, placed at the root of the sting; and it is this venomous liquid that occasions the inflammation and swelling, which always attend on the sting of a bee.

Lucy. The little stings, I think, move just like the saws of the tenthredo.

Mother. Yes, much in the same way. If the person, who is stung, has patience and resolution to wait quietly till the bee disengages its sting, the wound is not nearly so painful, as when it is left sticking in the flesh.

Lucy. But how can the bee pull it out? for you know the barbs fasten it in the flesh.

Mother. The bee has the power of closing the barbs flat to the side of the stings, by which means it can gently draw them out, and replace them within the sheath; but if it is suddenly driven away, before it has time to do this, the sting remains, and with it the bag of venom, as well as part of the intestines, n consequence of which the bee dies.

Lucy. If bees but seldom use their stings, for what purpose are they provided with them?

Mother. They serve for defence: bees have many enemies, to which they would fall an easy prey, if unprovided with any weapon of defence.

Lucy. You said that hornets killed them, to suck their honey bags; what other enemies have they?

Mother. Among birds, the swallow and tomtit devour a vast number; and the sparrow not only eats them whole, but has been seen carrying to its nest a bee in each claw, and another in its beak. Both wasps and hornets tear them in pieces for the sake of their honey bags. Frogs and toads also eat them, when they can catch them; but they can do but little harm, from their want of agility. The field mouse, and a little caterpillar, make the greatest havoc among the poor bees.

Lucy. But why do they not sting the mouse to death; a number of bees could do it in a minute?

Mother. The mouse is too wise to attack the bees in the day time; but when the nights are grown cold, and the bees are become torpid, it creeps into the hive, and destroys them by thousands, just eating off the head and corslet. Their most dangerous enemy is the ca-

terpillar of a little grey moth, called the *wax moth*, which contrives to lay its eggs in the very comb, probably at night, when the bees are asleep. The caterpillar, which in a few days quits the egg, is white, with a brown scaly head, and so small that it is hardly visible; but it is no sooner hatched than it spins a little hollow cylinder, in which it fixes its abode.

Lucy. What is a hollow cylinder?

Mother. A hollow cylinder is a circular tube, of equal breadth in every part; the tube of a telescope, for instance, is cylindrical; or a sheet of paper, if evenly rolled up, so that you can see through it, forms a cylinder.

The little tube in which the caterpillar lives protects it from the vengeance of the bees; and as it must put the head and the first ring of its body out of this case when feeding, these parts are made so hard and shelly as to resist their stings.

Lucy. But surely such a little worm could not kill a bee?

Mother. It does not attack the bees; the mischief it does is by devouring their waxen cells. The cylinder that it first spins is just its own length, and is fixed to the side of a cell; when all the wax within its reach is consumed it must advance in quest of more food; it therefore makes such an addition to the tube as may be necessary, and enlarges it in proportion to its own increasing size. Thus eating the wax, and lengthening its dwelling, it gradually winds round the combs, and effectually destroys the labours of the bees; and sometimes there are such numbers of these caterpillars in a hive, as to eat and break down the greater part of the combs. I have seen several in hives that have been opened, though in this country they are not so common as abroad.

Lucy. You said, some time ago, that, if the queen were killed, or lost, the swarm might be supplied with another queen; where is she to be found?

Mother. Every old hive, besides the

great number of drones and labourers, rears six or eight young queens. In four or five days after a queen is hatched, she quits the parent hive, and is followed by all the bees, that exceed the number sufficient for the hive. Sometimes two queens fly off at the same time: on such occasions fierce battles take place between the two parties, and the contest lasts till one queen is killed, when the bees immediately follow the survivor. At other times the two queens fight a single combat, and the swarm obeys the conqueror: but should both queens be killed, a skilful manager of these insects procures another young queen from the parent hive; round her the bees quickly collect, and again return to their peaceable habits.

Lucy. I think, mamma, that whoever searches among them for a queen must have great courage.

Mother. Or rather gentleness and calmness. The person must be careful not to breathe upon the bees. They

appear to have a very acute smell, and are known to have a dislike to most strong scents, particularly to that of horses and stable litter.

Now, my dear, I have related a few of the principal facts, which distinguish the honey bee; to-morrow I intend to give you a short account of some other species of bees.

DIALOGUE XXXII.

WILD BEES. APIS MUSCORUM, OR HUMBLE BEE. A. MURARIA, OR MASON BEE. A. CENTUNCULARIS, OR LEAF-CUTTER BEE. A. PAPAVERIS, OR TAPESTRY BEE.

MOTHER. Are you prepared, Lucy, to hear the wonders of the wild bees' nests?

Lucy. Yes, mamma, quite ready; but by wild bees, do you mean the large humble bee that hums about in the meadows?

Mother. That is one species, and we will begin with it; but there are a great many others. The *apis muscorum**, or

* From *Muscus*, moss.

humble bee, is sometimes called the *humming* bee, and sometimes the *carding* bee.

Lucy. Carding bee! why carding?

Mother. Because it is said to card the moss of which it builds its nest: to card wool is to divide, or comb it with a tool somewhat like a brush, formed by a number of wire teeth closely set in rows, and fixed in a flat wooden frame, with a handle on one side; but our little carder has no tools, except its jaws, and feet.

Lucy. How such tiny things as a bee's feet can card the coarse moss I cannot imagine.

Mother. This bee is among the insects that are the earliest awakened from the winter's sleep, by the warmth of spring. It immediately begins to construct a nest, for which a mossy spot of ground is selected; and having prepared some moss, and spread it bit by bit, so as to form a thick, smooth carpet, it next proceeds to ransack the early flowers for wax and honey. Of these a kind of

paste is made, in which the bee lays three or four eggs, and covers them over with an arched roof of moss and wax, to preserve them from the rain. She then proceeds to collect more materials, and to deposit more eggs. Her first laid eggs are quickly hatched, and in a few days having eaten up all the paste in which they were placed, they change to nymphs, and from nymphs to bees; and they are no sooner bees, than they begin to work, under the directions of their mother. The first job is to enlarge the nest.

Lucy. I suppose she employs them to card the moss, and to bring it home?

Mother. Yes, they assist her; but this work is performed in a very curious manner: the queen mother takes her little party to the nearest tuft of nice moss, and dragging out some of it, she first combs it, and then neatly mats it up into a little ball, with her jaws and fore legs; with the other two pair of legs she pushes this ball under her to the next bee which stands close behind her; and this bee

pushes it on in the same manner to the third, and so on till it is conveyed to the nest. If the line of bees should not reach from the bank of moss to the nest, they again place themselves in the same order, and beginning where the first line ended, they repeat the same manœuvre till a sufficient quantity of moss has been provided.

Lucy. How delighted the person must have been who first observed this manner of building the nest! Do the carders lay by any honey, as the hive bees do?

Mother. In each nest, there is generally four or five cells of very good honey; the cells are considerably larger than what we find in hives, and are made of a much coarser kind of wax. When mowers find them in a meadow, they suck the honey, and find it very palatable.

Lucy. If the humble bees have any enemies, they must be an easy prey, building as they do on the ground.

Mother. They, like all other creatures,

have their enemies; field mice often destroy their nests, and polecats sometimes make sad havock among them: but they suffer most from some kinds of caterpillars, which eat up the larvæ at all ages, and now and then even the old bees.

Lucy. When a nest is of its full size are there many bees in it?

Mother. Sixty or seventy is the usual number; but they have been known to amount to two or three hundred.

There are some species of wild bees, which are termed *solitary*; instead of their habitations being the joint effort of the whole society, each female constructs a nest for her progeny, and then returns to it no more.

Lucy. That is like the sphex, who builds its nest with so much labour, and then leaves it.

Mother. Just so. The first I shall mention is the *mason bee, apis muraria**,

* From *Murus*, a wall.

whose nest has the appearance of stone, and costs her incredible pains; she first chooses the kind of sand that answers her purpose, and then glues grain by grain together with a liquid, which she throws out from her mouth; when a round ball has thus been formed, as large as she can carry, she flies with it to the spot, on which she has previously determined, in some warm, sheltered wall, and there fixes it as the foundation stone. With a number of similar balls, about the size of small shot, and firmly attached to each other, she constructs a cell about an inch high, and a little more than half an inch in diameter; and then, with a still finer sort of sand she gives it a smooth, polished lining. She next goes to the fields, and brings home a quantity of honey, and of the farina of flowers, which she works into a paste, and with it fills about two thirds of the cavity; on the paste she deposits an egg, and then, with the same kind of sandy mortar, she covers over and completes this first cell. Another is

constructed in the same manner, in contact with the first; six or eight cells, which this industrious little mason builds in as many days, compose a nest; and outside of the whole she adds a rough coat of coarser sand, so that the entire fabric appears like a stone projecting from the wall.

Lucy. It is most surprising how so many curious circumstances were ever found out.

Mother. We are indebted for these details to the patient and indefatigable attention of various naturalists; but chiefly to Reaumur, a French philosopher, who flourished in the beginning of the last century.

Lucy. As you say, mamma, that every insect has its enemies, I suppose even the stone house of the mason bee does not entirely protect it?

Mother. You are very right, Lucy; there is a species of *ichneumon,* which is provided with a boring machine, that can pierce through the artificial stone into the

nest; there it lays its eggs; and the larvæ have such strong jaws, that they cut their way from cell to cell, and prey upon both the bee bread and the young bee.

It has another deadly enemy in the *attelabus apiarius;* a little beetle, which is very beautifully marked: the head and corselet are of a fine blue, the elytra are red with three violet coloured bands, and the under part of the body is covered with long, white hair. It watches for the absence of the bee, and slily introduces an egg into her nest; from thence a rose-coloured worm proceeds, with a black head, and six scaly feet, who soon devours the young bees, and then weaves for itself a strong case, like parchment, lined with silk, in which it goes through its transformations, and remains in the chrysalis nearly three years.

Lucy. Pray, mamma, have these wild bees stings?

Mother. Yes, all the females have stings; but they are not easily provoked

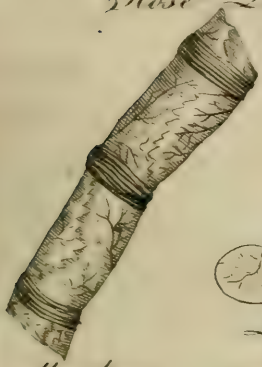
to use them. Very different from that of the mason bee is the mode of constructing its nest adopted by the *leaf-cutter* bee, *apis centuncularis**, but executed with full as much address. She excavates a hole in the ground, about the size of a large quill, and there forms six or seven cells, of pieces of green leaves, which she rolls up, and fits so accurately as to retain the store of honey for her progeny; these cells are somewhat wider at the mouth than at the inner end, and being inserted into each other they resemble a succession of small thimbles. As each cell is finished, the due allowance of food is put in, the egg is deposited, and the orifice is closed with three circular pieces of leaf.

Lucy. What ingenuity this little animal must have!

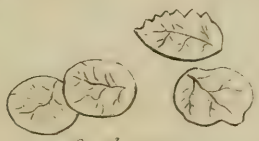
Mother. Yes, Lucy, and I will give you another proof of it: as the innermost

* Plate XX.

Apis Centuncularis
the
Rose Leaf cutter Bee.



the cells when perfect.



Leaf circles for the tops & bottoms

a cell, cut open

Apis Muscorum
the
Humming or Carding
Bee.

Published November 1. 1818, by R. Hunter. St. Paul's Church Yard, London.

cell is first made, the egg placed there must consequently produce the first born bee of the family; now, you perceive, that, if this bee were to force its way outwards, it would derange the cells, and kill the other young bees in its progress.

Lucy. So then, that poor thing must remain imprisoned till all the rest are hatched.

Mother. No, Lucy: when the bee worms are going to become nymphs, they spin cases, lined with shining white silk; and in these the nymphs instinctively place themselves with the head inwards; inwards, therefore, on becoming bees, they are forced to work their way, and there they find a passage carefully provided for them. For the mother bee, as soon as she had completed the nest, had dug from the surface of the earth to the innermost cell a subterranean path, through which the young bee makes its exit, and all the rest of the family follow by the same road.

Lucy. Any sort of leaf, I suppose, serves for these nests?

Mother. There are three or four varieties of leaf-cutter bees, and each of them has its favourite tree; the apis centuncularis usually employs the rose leaf. Have you never observed rose leaves, with round pieces cut out of them?

Lucy. Indeed I have; but I never should have guessed that any thing so exactly round could have been cut by a bee; how does it cut the leaf so nicely?

Mother. With her mandibles, or jaws, which are both strong, and sharp; alighting on the edge of the leaf, she holds it between her fore feet, and rapidly moving forward she separates a piece, of the precise shape and dimensions that she wants, though unprovided with either scale, or compasses. At the last nip she gives, she spreads her wings, and instantly flies away with her prize.

Lucy. That is very pretty; I will

certainly watch the rose trees very closely, in hopes of seeing this clever little creature at work. Do all the leaf-cutter bees make their nests in the same way?

Mother. They select different places for their nests, some choosing the trunks of old trees, and others the posts used in paling, which they completely perforate. Another species of this industrious tribe, the *apis papaveris* *, a native of France, has been called the *tapestry bee*, because the floor and walls of its nests are lined with scarlet hangings.

Lucy. It probably spins a kind of scarlet silk.

Mother. No, they are made with the petals of the scarlet field poppy flower, which she cuts into oval pieces, and carries one by one in her claws; if they are crumpled, in the subterraneous passage to her dwelling, she stretches and smooths them neatly with her little

* From *Papaver*, a poppy.

feet, and then glues three or four layers of them round the cavity in the ground, which is about three inches deep. Having lodged the proper quantity of bee bread, and placed her egg, she covers them over with the same leaves, at the height of an inch from the bottom of the hole; and lastly, she fills the remaining two inches of the passage with earth. For each egg she makes a separate nest. By the time the worm has consumed the stock of food, it changes to a nymph; and the next summer, when the poppies are in flower, the bee comes out, and follows the industrious example of its parent.

Lucy. How nicely it is contrived, that the bee should just come to perfection at the season when the scarlet tapestry and carpets are quite ready for its use!

Mother. Yes, my dear Lucy, the same power, that impresses these insects with certain habits, assigns the means of

supplying their wants, and calls them into winged life at the proper moment.

There are many other species of bees, which would afford you equal entertainment; but we must reserve them for our future studies.

DIALOGUE XXXIII.

ANTS. FORMICA NIGRA, OR BLACK ANT. F. BRUNNEA, OR BROWN ANT. F. RUFESCENS, OR RUFESCENT ANT. TERMITES, OR WHITE ANTS.

LUCY. Mamma, here is a little fly, which I have brought in to show you; I found it in the sunny lane, leading to the west wood, where we were taking our morning's walk. You never saw such numbers as there were flying through the air, and lighting in crowds on our white frocks.

Mother. Put it under this glass; we may examine it there without hurting it. What order does it belong to?

Lucy. To hymenoptera, I believe, because it has four membranaceous wings.

Mother. You are right: now observe the other peculiarities, and let me see if you can find out its name.

Lucy. The body is so deeply divided from the thorax, that the fly seems to be almost cut through; and there is a sort of scale between the thorax and abdomen, which I do not think you have yet described to me.

Mother. Now look over these different genera in hymenoptera; perhaps you may find one of them with some characteristic answering to that scale.

Lucy. Sphex, ichneumon, vespa, apis. Oh yes, here is the *formica, or ant,* which has a scale.

Mother. Very well: read the description.

Lucy. "Formica, an erect *squamula* (or scale) between the thorax and the abdomen—antennæ filiform—head large—females and neutrals have a sting concealed—females and males have wings; neutrals, or labourers, none." Then,

mamma, ants are like bees, in having males, females, and workers?

Mother. Yes; and they also resemble bees in living together in large societies, where all the works are carried on in common for the public good, and conducted with the greatest order and dispatch.

Lucy. I suppose there are ants' nests near the wood lane?

Mother. They are fond of making their nests in banks and uneven ground, where there are rough hillocks; and sometimes near the roots of trees. They hollow out a sort of vaulted cavern, to which they make several subterraneous passages; and for all this work, so prodigious when compared with the bulk and strength of the animal, they have no other tools than their jaws; but what they want in strength and tools they make up in numbers and diligence, multitudes of labourers working at once in carrying out the earth.

Lucy. But they must be in each other's way?

Mother. The regularity of their proceedings prevents all confusion. They never enter the nest by the same passage which they use for going out; therefore, when laden with the earth, which they carry away in their jaws grain by grain, they always find a free road, as those that have discharged their burdens are then returning by a different avenue. The inside of the cavern is divided into numerous cells; in some the eggs are placed; in others the nymphs, wrapped up in pale yellow cocoons; and the care and attention bestowed on both is admirable. The eggs are extremely small; they are laid in spring, and the little worms, which are hatched in a few days, are constantly attended and fed by the workers, till they have reached their full size; this is usually in June, and the larvæ then spin their webs.

Lucy. And then, I suppose, the poor labourers may rest awhile?

Mother. No; they transfer their care to the pupæ, which are carried out into the air on mild, soft days, or placed higher or lower in the nests, according as the heat or cold of the weather vary.

Lucy. What constant trouble! And how long do they remain in the pupa state?

Mother. Something more than a month. In August the nest is full of young ants of all the three ranks. The females are more than twice as large as the males, and both are furnished with wings; but the neuters, or labourers, have none, and are of a size between the others.

Lucy. The labourers, I suppose, bring home food to the larvæ, as bees do? What do they chiefly eat?

Mother. They eat fruit, dead insects, and flesh of all sorts: with surprising dexterity each individual cuts off a little piece to carry home; or many ants, uniting their strength, drag the whole mass to the nest. I have often seen a great

fly, or a dead beetle, a hundred times as large as themselves, conveyed, by their joint efforts, from a considerable distance. Scouts are often sent out to discover food; and, if they bring home any promising intelligence, thousands immediately repair to the spot, following the little spy in a single line, one after the other.

Lucy. What kind of food, mamma, do they lay up in store for the winter?

Mother. They are in a torpid state during most part of the winter, and therefore do not require any provisions.

The ant, which we have here, is the *formica nigra**, a very common species; but I will now give you some interesting particulars of a large brown ant†, which might be called the mason ant.

Lucy. I suppose, then, it builds a solid house, like that of the industrious mason bee?

Mother. Its dwelling is very ingeniously built; but it works in society, as do

* From *Niger*, black.

† *Formica Brunnea* of Latreille.

all the species of ants; the nest is of great size, and divided into stories, placed one over the other, like those of a house, and each containing a suite of large apartments, besides smaller rooms, or cells: some nests have been known to contain twenty stories above-ground, and twenty more under-ground. These ants cannot bear much heat; in dry weather, when the sun shines brightly, they remain at home, shutting their doors to keep out the heat, and placing sentinels to prevent the intrusion of other insects: but on the first shower of rain they resume their work. Some are skilful masons, and build with the earth, which is brought to them by others, who are employed in mining and digging; and when the structure is of the requisite height they strengthen it by adding buttresses at certain distances all round the walls. The ceilings of the large apartments, which are often two inches across, are supported by pillars of clay; the smaller chambers are vaulted, and nothing

can be more admirable than the dexterity with which the arches are formed, each particle of earth being made to project a little beyond that to which it is cemented, till the two side walls, gradually rising, meet in the middle and sustain each other. Some of these rooms have doors in the side, or end, walls; others have apertures in the floor, or ceiling, to communicate with the adjacent stories; but all are connected throughout the whole fabric by passages, which generally terminate in the large central apartments, like the streets of a well laid out city, that meet in a square, or market place.

Lucy. It is, indeed, like a city; a most surprising city!

Mother. All goes on well as long as the weather is damp; and so assiduously do they work, that an entire story is completed in a day, or rather in a night, which is the time they usually prefer for their labours: but should a drying wind come before the building is roofed in, they can no longer temper the earth, for

want of rain; and, as the unfinished parts would crumble away, they throw down all the uncovered cells, and, scattering the materials in readiness to receive the next moisture, they retire into the lower part of the nest.

Lucy. But how do they manage about shaping their building? Does one master ant, like an architect, lay out the plan for the rest to follow?

Mother. That has not been ascertained; and though they certainly work together most harmoniously, it does not appear that there is any superintending eye; on the contrary, they make frequent mistakes; the following singular instance of which will amuse you. Separate divisions of an edifice having been rapidly carried up by separate parties, it was found, on their approaching each other, that, instead of accurately meeting, there was a considerable difference in the height of the corresponding ceilings: the error was at length perceived; a consultation ensued; the low part was imme-

diately demolished, and new walls and ceilings were rebuilt at the necessary elevation.

Lucy. Do these brown ants eat insects and meat, as the black ants do?

Mother. They eat fruit, and a great variety of articles; but their favourite food is a sweet fluid, like honey, which is obtained by a small insect, the *aphis,* from the sap of vegetables.

Lucy. Then they kill the aphis, I dare say, and suck its honey, as the wasp serves the bee?

Mother. No; they seem to have a mutual friendship for each other, and their interchange of good offices is quite voluntary. The ants defend the aphides from their enemies, assist in hatching their eggs, protect them when young, and frequently pat them on the back with their antennæ, in the same way as they caress their own young. A single aphis can give out enough of this sweet fluid to feed several ants; and is even thought to retain it for a considerable

time, till an opportunity offers of sharing it with the ants, who regularly go to solicit their food at the tree, or shrub, inhabited by the friendly aphis. If no aphides happen to have established themselves near the nest, the ants have been known to select some particular species, that feed on grass and roots, and to carry great numbers of them into their immediate neighbourhood, or even to lodge them in the nest, where they assign them particular apartments, and supply them with food, in order to enjoy that favourite beverage without stirring from home.

Lucy. In winter you said the black ants become torpid; do the brown ants also?

Mother. Yes, they do; but not before the cold is very severe; when the thermometer falls to five or six degrees below the freezing point, they become lethargic; and it is remarkable, that the aphis also becomes torpid at the same degree.

Lucy. This is, indeed, mamma, a

most singular history. So then these ants keep their herds of milch cattle much in the same way that we keep our herds of cows or goats. It is the first instance that you have mentioned of two different kinds of insects living together on terms of friendship; all the rest seem to avoid or to prey upon each other.

Mother. It is a curious circumstance; nor do I recollect any thing similar to it among all the other tribes of insects. But, my dear Lucy, I have selected only a very few particulars in the economy of these sagacious animals; there are many, which would appear almost incredible if they were not well authenticated. For example, nests of ants have regular pitched battles with each other, in which they practise all the stratagems of the most skilful warfare; they fight with the most inveterate obstinacy, and leave the field of battle covered with slain.

Lucy. One can readily imagine, that two ants might quarrel for a dead fly, or

some nice bit of food; but what possible motive can whole nations of them have to quit their employments, and make war on each other?

Mother. Indeed, Lucy, the same question would equally apply to half the wars which have deluged the world with human blood. Ants are very irritable, and a single combat often brings on a national conflict; sometimes they dispute the possession of a bit of ground adjoining their cities; and their valuable herds of aphides are constant sources of contention. But you will be yet more astonished when you learn, that some of the wars of these little wretches are actually for the purpose of making slaves! If the assailants are victorious, the nest of the conquered party is immediately invaded, and all the pupæ are carried off in triumph: these are carefully nursed till they have arrived at maturity, and are then employed in all the domestic drudgery; they repair the dwelling, attend to the aphides, and feed, or even

carry, their masters, who pass the rest of their lives in luxurious indolence. These piratical ants, the *formica rufescens*, are of a reddish colour, while the species, from which they make their captives, are black, and are thence aptly called the Negro ants.

Lucy. How delighted I should be, mamma, if you would show me some of these wonderful cities of the brown ants, and the still more wonderful battles of those slave-making ants.

Mother. None of those species inhabit this country; but when you can read French more fluently, you shall see some very extraordinary details of the sagacity and singular habits of these creatures, in a book written by the celebrated P. Huber, of Geneva. In the mean time, I will show you a part of Mr. Smeathman's entertaining account of the white ants, or *termites*, of the coast of Guinea. Strictly speaking, however, they are not ants, as they belong to the order neuroptera; but their habits are, in many respects, similar;

living, like them, in a state of society, dividing their labours, and displaying the same ingenuity in the construction of their nests. Some of these are great hills, of ten or twelve feet in height; and others, circular towers, of equal diameter at the base and summit, where they are covered by a pointed roof, with a projecting eave, as you shall see in his plates.

DIALOGUE XXXIV.

ORDER DIPTERA. ŒSTRUS, OR GAD FLY. Œ. BOVIS, OR OX GAD FLY. Œ. OVIS, OR SHEEP GAD FLY. Œ. TARANDI, OR REIN-DEER GAD FLY.

MOTHER. We are now, Lucy, I think, sufficiently acquainted with the order *hymenoptera,* and may proceed to the sixth order, which is called *diptera.*

Lucy. Ptera, I know, means wings; what does the other part of the word mean?

Mother. It is derived from a Greek word, signifying two; diptera, therefore, means the two-winged order, and all its genera consist of insects having only two membranaceous wings.

Lucy. Then all the common black flies are in this order?

Mother. Yes, all; and a vast variety of others. *Dipterous* flies have two *halteres**, or poisers; and these appendages are peculiar to them.

Lucy. What are halteres, mamma?

Mother. They are little knobs, at the end of short *pedicles,* and are something like the stamens of a flower. The knobs are supposed to be hollow, as it were little bladders filled with air. There are two of them, one placed under each wing.

Lucy. What can be the use of these little things?

Mother. Naturalists do not seem to have decided this point: some think, that they assist the fly to balance itself, and for that reason they have been called poisers; and others imagine that the buzzing sound, made by flies when on the wing, is produced by these organs.

* Weights held by ropedancers, as counterpoises.

Oestrus Bovis. Ox Gad-fly.

Pupa case
and lid.

Larva of the Oestrus Bovis.

Published November 1. 1818. by R. Hunter. St. Paul's Church Yard. London.

It has also been supposed, that by the buoyancy of these little bladders, which the fly can dilate or contract at pleasure, it is enabled to rise, sink, and move freely through the air; somewhat in the same way as the air vessels of birds and fishes facilitate their movements.

Lucy. Here is a Harry-Longlegs in the window; I see the halteres plainly; they are quite close to the head of the wings.

Mother Yes, they are very distinct in that kind of fly; but in some species they are but just perceptible.

The first genus in diptera is the *œstrus*, or *gad fly*.

Lucy. Is not that the fly which sometimes sets horses mad?

Mother. It is, however, often falsely accused, for there are many other flies, which torment them terribly. One species, the *œstrus bovis**, attacks our cows. This fly is as large as a drone bee, and

* *Bos, Bovis,* an ox. Plate XXI.

resembles it so much in its general appearance, that it might be taken for one, unless the observer were near enough to distinguish that it has but two wings.

Lucy. Does it sting very severely, like the bee?

Mother. It cannot be said to sting, as its attacks are not made with that design; its sole purpose is to lay its eggs.

Lucy. That is like the ichneumon, which gives the wretched caterpillar so much pain.

Mother. The instrument, with which the gad fly makes an incision in the skin of the animal, in order to deposit its eggs, is still more curiously formed than that of the ichneumon: it is composed of four tubes, one within the other, so that they push out like those of a pocket telescope. The outer tube is hard and shelly, and the inner one is terminated by five sharp points, of which three are hooked: with these it rapidly bores a hole through the roughest hide, and, guided by the tube,

the eggs slide down into the wound. There the warmth of the beast soon hatches them, and the larvæ, or worms, feed on the matter produced by the sore.

Lucy What odious little creatures! But do not they hurt the cows most dreadfully?

Mother. At the moment of boring the hole, and inserting the eggs, the cattle seem to suffer very much; but afterwards the tumours they create do not, as far as we can judge, occasion any serious pain: I have even heard, that in Norfolk, and Suffolk, they are reckoned useful; and that, as the œstrus selects the healthiest cattle, the farmers prefer those cows, which have on their back three or four of the lumps, or *bots*, produced by this insect. The cattle are, however, thrown into the greatest agitation and distress at the sound of its well-known buz; they run about the field, lashing their tails, and bellowing with apprehen-

sion, or plunge at once into the water, where the œstrus seldom follows them.

Lucy. How long do the larvæ live on the poor cows?

Mother. The fly seldom appears till June, and the larvæ generally quit their abode in Autumn, and immediately burrow in the ground; their skin then gradually thickens, and becomes so hard, as to answer the same purpose as the outer case of other chrysalids. Within this hardened skin the worm in time becomes a nymph; and remains in this state till the following summer.

Lucy. I think, mamma, that the maggot's own skin becoming hard, and forming the pupa case, is a different mode from any you have yet mentioned; but how does the fly get out of it?

Mother. I am much pleased, my dear Lucy, by the attention you pay: you are very right, this manner of changing to the chrysalis I now mention for the first time; but it is common in this order.

That part of the hard skin, or shell, which is nearest to the head, is attached by a slender filament, or thread, as the lid of a box is by the hinge; this filament yields to a very slight pressure from within, the door opens, and the fly escapes.

Lucy. Are horned cattle the only creatures which the gad fly attacks?

Mother. There are three species, which deposit their eggs on the coat of the horse; two of these, by a wonderful instinct, place them on his lips, or within reach of his tongue; when licked in, and unconsciously swallowed, they are hatched by the heat of his stomach. The œstrus ovis *, or sheep gad fly, is a dreadful pest to sheep; it lays its eggs in their nostrils, from whence the maggots creep into the interior of the head, and afflict those poor animals with such pain, that they seem to fall into a sort of frenzy;

* From *Ovis*, a sheep.

regardless of their usual tranquil habits, they leap, and bound, or dash their heads against the trees; and this state of extreme anguish and irritability returns every time the larvæ change their places.

Lucy. The poor sheep, then, must constantly suffer, for I suppose their persecutors often move?

Mother. The larvæ have two barbed claws, by which they probably stick fast in one spot till all the food within reach is consumed. When ready to become nymphs, they let themselves drop from the sheep's nose to the ground, and go through their changes in the same manner as the first species which I described. There are twelve species of this fly, but the last which I shall mention is the œstrus tarandi *, the implacable enemy of the rein-deer, into whose flesh, like the *œstrus bovis,* it introduces its eggs. The

* From *Cervus Tarandus,* the rein deer.

distracted deer, with headlong speed, fly from the plains to the cold tops of the mountains, whither the fly never pursues them; but those, which have not been able to escape, become thin, weak, and unhealthy. It is calculated, that, from this cause alone, a fourth part of the rein-deer of Lapland die, before they reach the age of two years; an irreparable loss to the poor Laplander, whose chief comforts are derived from that useful animal.

Lucy. The rein-deer are driven in sledges, as I remember to have heard papa tell my brother William; but for what else are they useful?

Mother. The Laplander is clothed principally with their skins; their flesh forms a great part of his food; and the rich milk, which they yield, affords the most wholesome and nutritious diet, both in summer and winter. They not only draw his sledge, but are trained to carry the tent and household goods when a family is changing its abode, a measure

often necessary in the sterile soil and capricious climate of Lapland.

Lucy. But, mamma, how can they have milk in winter in such a country, when it is scarce even in England?

Mother. In the beginning of winter the milk is exposed, in large shallow pans, to the influence of the frost; and when thoroughly frozen into cakes, it keeps perfectly well during the cold months: when used, a piece is broken off and melted, and being exceedingly rich, it bears to be mixed with a large proportion of water. In Von Buck's Travels, you will find a very entertaining account of the whole process; at present, as I cannot afford you more time, we will finish our conversation with the description of the genus œstrus. Antennæ taper, each proceeding from a small protuberance — the mouth only a simple orifice — palpi two — and stemmata three. The species œstrus bovis is thus described: thorax yellow, with four short lines — abdomen tawny, with

a black band—last segment dark and orange coloured hairs—wings and poisers white—legs black, with pale feet. The larvæ are short, thick, and soft—without feet—and brown, with transverse lines and black dots.

DIALOGUE XXXV.

MUSCA, OR FLY TRIBE. M. CHAMÆLEON, OR CHAMELION FLY.

MOTHER. In the genus of insects, which I shall describe to-day, many species are familar to you: I have often heard you complain of their annoying buzz, and of the freedom with which they light upon your face.

Lucy. I think, mamma, it must be of the common flies you mean to speak?

Mother. It is. In the genus *musca*, or fly, there are above five hundred species; but out of this great number I shall only select a few. The genus is distinguished by a soft, flexible proboscis, or trunk, with lateral lips at the end; some have two short, simple antennæ,

and others have, in addition, two lateral hairs, one fastened to each of the antennæ.

Lucy. What does lateral mean?

Mother. Growing out of the side is to grow laterally; in the common house fly you may distinctly see those lips at either side of its trunk, when eating. The *musca chamæleon** is the first species which I shall mention. It lays its eggs in the hollow stalks of rushes, and other aquatic plants. The shape of the larvæ, which come from these eggs, is very remarkable: from the mouth the body gradually increases in thickness for about one third of its whole length, and then tapers towards the tail, where it again expands, something like that of a fish. Round the tail are placed thirty feathered filaments, or hairs, which never become wet, though under water; and in the centre, from whence they diverge, there are two *spiraculæ.* The body is

* Plate XXII.

covered with a rough granulated skin of various colours; and is divided into twelve rings, of which nine are perforated by *spiraculæ*, having one on each side; do you remember what they are?

Lucy. Yes, I do. They are little breathing holes, and are generally marked by a coloured ring close round them.

Mother. Very well. This larva is very slow in its motions, and never moves horizontally through the water as fishes do. When at rest it expands its circular tail of filaments upon the surface of the water, like a fan, from which the body, that always hangs downwards, seems to be suspended.

Lucy. Do these curious creatures inhabit our ponds?

Mother. I believe they may be very commonly found there; but we seldom think of seeking for those wonders, which are a little out of our beaten path. I had once the pleasure of finding one of these larvæ in my water glass, after dinner, where I could readily observe its motions;

on each little filament there was a bright globule of air; and when the animal wished to change its place, by twisting, or bending its body from side to side, it was able to effect a slow progress through the water.

Lucy. How beautiful the little diamond globules must have appeared round its fanned tail!

Mother. Yes, it was a very pretty sight. When it chose to descend, it contracted, or drew in, the points of the filaments towards each other, resembling, in shape, a hollow pear, and inclosing between them a large globule, or bubble, of air; thus transforming its fringed tail into a little air balloon, which always kept that end uppermost.

Lucy. But how did it procure the air, and force it into the balloon?

Mother. It seems to have the power of forcing the air from its own body into the little balloon. As it sinks in the water the bubble is often allowed to escape, though instantly replaced by an-

other; but, in ascending through the water, the globule is constantly retained between the filaments, till they may be expanded on the surface.

Lucy. What a quantity of air this little creature must have in its body!

Mother. Naturalists have not yet ascertained how it is able to produce all this air, by the management of which it can sink or swim at pleasure.

Lucy. What does the larva eat?

Mother. It appears to live entirely by suction, as it has neither jaws nor tongue; but in the middle of its mouth there is a single horny beak, like the upper part of a bird's bill, to each side of which is attached a short, fleshy organ; and these it has the power of protruding, or of retracting, when not wanted. They seem to answer the joint purpose of hands and feet; for, in the water, they serve to stir up the mud, so as to allow the beak to work in it more easily; and they are employed as feet, when the animal quits the water.

Lucy. It is then an amphibious insect?

Mother. No; it never quits the water till near the time of changing to a nymph; it then drags itself along the bank to a proper spot, where it can lie with a part of its body under water, and there it remains.

Lucy. Does it remain long in that situation?

Mother. Soon after it has become stationary the body begins to shrink, or shorten; and in about twelve hours the four rings next the tail, and one or two next to the head, are found empty, which may be seen by holding it up to the light, as the skin is in some measure transparent. The nymph is closely folded up in a thin case, and, if this is cautiously removed, the future fly may be distinctly perceived. In this state it remains several days, when, in consequence of the efforts of the little prisoner, the outer skin splits along the third, fourth, and fifth rings, and the fly escapes.

Lucy. When the fly is come out, on what does it prey?

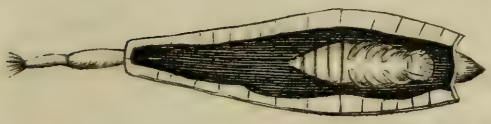
Mother. The habits of the perfect insect are less known than those of the larva: by some it is supposed to be carnivorous; others think that it subsists on the honey of flowers; and one naturalist asserts, that it can live without any food for nine months.

Lucy. You said, mamma, that the skin of the larva was granulated; what is that?

Mother. Granulated, strictly speaking, is to consist of grains; but, applied to the texture of a skin, it means a rough appearance, like that of shagreen. The little protuberances of the larva, when highly magnified, resemble limpet shells, as you may see in this drawing*.

* Plate XXII.

Musca Chameleon.



The Skin of the Larva divided to shew the Pupa within side

Part of the granulated skin magnified.

Larva of the Musca Chameleon.

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DIALOGUE XXXVI.

MUSCÆ, OR FLY TRIBE. MUSCA TENAX.

LUCY. The fan-tailed creature, mamma, which you last described to me, in our nice insect conversations, is a most curious little animal, with its bubbles of air, and its tiny air balloon at its tail. Do the larvæ of any other flies, muscæ I mean, live in the water?

Mother. I am glad to find, my dear, that, after so long an interval as ten days, you accurately remember what we last discussed, and that you seem to return to the subject with pleasure.

Lucy. Indeed, mamma, there are few things which I learn with so much pleasure as these curious histories of insects;

and when I walk out, I find great sport in watching the bees and flies upon the flowers and bushes.

Mother. The animals, which I shall describe to day, do not live among flowers or bushes, nor in water, but in ditches and other filthy places. There are several kinds of muscæ which deposit their eggs in those situations; one species lays them in clusters of forty or fifty, and in such a manner, that the moment the worm comes from the egg, it can creep into the moist dirt, which is suited to its habits.

Lucy. Are these larvæ shaped like those of the chamelion fly?

Mother. No, they are very dissimilar in shape, but they breathe in the same manner through the tail. The body is rather more than half an inch long, and somewhat resembles a tadpole. Have you ever seen a tadpole?

Lucy. Oh yes, last spring Fanny showed me numbers of them from the old steps at the brook, and she told me they were young frogs.

Mother. Very well; these little creatures have much the appearance of those tadpoles, but the body is longer in proportion to its thickness; and it is possessed of seven pair of feet, which are very small.

Lucy. Do they ever walk out of the water?

Mother. Yes; they are sometimes found crawling slowly on the damp ground; but this seldom takes place till they are in search of a secure corner, in which to go through their changes.

Lucy. Perhaps they use their little legs to creep upon the mud at the bottom of ditches.

Mother. Possibly that may sometimes be the case; but, as they are incapable of living without a constant supply of air, they can walk only in the shallowest water. Their food they seem to find in the dirt, which they root up with their heads; for which reason they have sometimes been called *hog worms.*

Lucy. What colour are these little dirty creatures?

Mother. They always appear of the same hue as the mud in which they are found; for it strongly adheres to their clammy skin; but if washed they are found to be white, and so transparent, that their air vessels can be distinctly traced. Of these air vessels there are two, which, in the middle of the body, are of considerable size, but lessen in thickness towards the extremities, and they run along its whole length, like two parallel stripes. When the tail is stretched out, these air vessels become so slender as to be nearly imperceptible; but when it is contracted, they enlarge, and as the tail shortens, they bend up in folds. The intestine, which contains the aliment, or food, is easily distinguished from the air vessels, by the dark colour of its contents.

Lucy. But, mamma, how do they lengthen or shorten their tails?

Mother. The tail is formed of two tubes; that next the body being the largest, and into this the animal can draw the smaller tube, which forms the farther half of the tail.

Lucy. Then I suppose they keep the tip of the tail above water, like the larva of the chamelion fly, and that it is for that purpose they are enabled to alter its length?

Mother. Yes; they lengthen or shorten their tail according to the depth of water; and not only by pushing out the smaller tube to its full length, but also by extending, or stretching, both the tubes, which are as elastic as a thin piece of Indian rubber.

Lucy. These little creatures do not seem to have any filaments at the end of the tail, like those of the fan-tailed larva.

Mother. Yes, they have; the tail ends in a fine point, from which proceed five hairs, that spread out upon the sur-

face of the water; but they are too minute to be observed, without the assistance of a good microscope. When the time for transformation is come, these larvæ creep out of the water, and having found a suitable place, they remain at rest for a short time: the body becomes thicker, the tail shrinks, and the whole skin assumes a shell-like hardness.

Lucy. The old skin, I suppose, answers for the case, within which they make their change?

Mother. Yes, it does; and some singular alterations then take place. The head loses its former shape, and the rudiments, or beginnings, of two pair of horns, are seen to burst through the old skin; the lower pair, with a slight bend, project nearly forward; while the upper pair first rise upward, and then gradually curve downward.

Lucy. What use can a chrysalis make of horns, for as it cannot move it cannot defend itself?

Mother. There are a few instances of chrysalids being endowed with the power of moving to a certain degree; and you know there are several genera of insects, particularly in one order, where the nymph is as active as the larva, and seems to differ but little from the imago.

Lucy. Oh yes, I recollect; the cricket and the grasshopper. But those insects, which change within a pupa case, and lie concealed for a long time, could make, I think, but little use of horns.

Mother. There are some pupæ, which can advance, though unable to move backwards. I think I have already mentioned the chrysalis of the *goat moth*, which has horns along its back; these horns, by acting against the bark, under which it lives, assist it to move forward, but prevent its retreating.

Lucy. I had quite forgotten this; but I believe you only mentioned it

slightly, and said, that I should hereafter read a full account of it.

Mother. Yes, my dear Lucy; and when I think you can understand the minute description that has been given of the wonderful structure of that caterpillar, you shall read it, and have the plates to examine.

The horns of these *rat-tailed* larvæ—

Lucy. Why rat-tailed, mamma?

Mother. Because their shape has some resemblance to a rat's tail, which you know is very long and slender. These horns quickly grow to a considerable length, and answer the same purpose as the tail did before transformation, and as the stigmatæ do when the insect has assumed its perfect state.

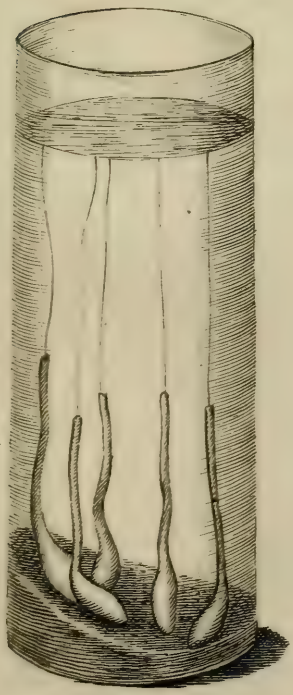
Lucy. The animal then breathes through these horns?

Mother. It does; they are spiracula, or breathing passages; and, in about twenty-four hours after they have attained their proper length, the fly is

Musca Tenax.

Pupa.

Larva.



The Larvæ as they may be seen in a glass of water, a small quantity of Mud in the bottom.

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found to be completely developed, or formed. It remains, however, a chrysalis for about ten days longer, when it emerges from its cell, a yellow and black fly, called the *musca tenax;* it is commonly seen hovering over flowers, and is often mistaken for a bee *.

* Plate XXIII.

DIALOGUE XXXVII.

MUSCÆ, OR FLY TRIBE. M. VOMITORIA. M. CARNARIA.

LUCY. I am very happy, mamma, that you can go on with the history of the flies to-day.

Mother. The *musca vomitoria* is the large blue fly, which is familiarly known to you by the name of the blue-bottle fly, and whose loud humming noise, on warm days, is so disagreeable. But it has other habits, which are still more disagreeable, particularly to butchers and cooks, for it places its eggs on any sort of dead animal flesh, and these eggs are hatched in the short space of a few hours. As soon as the maggots come out they begin to eat; in eight or nine days they attain their

full growth, and then change to the chrysalis state, in which they remain for ten days, before the imago makes its appearance.

Lucy. This is the fly, I believe, mamma, that seems to be so much afraid of wasps.

Mother. Very right; this fly is the most common of those species that spoil our meat: but the *musca carnaria** is a still greater nuisance, as it also frequents the larder and other places where meat is exposed, and at once produces worms instead of eggs.

Lucy. Worms! It differs, then, in that respect, from all other insects.

Mother. Several of the muscæ produce worms ready hatched; they are therefore called *viviparous.*

Lucy. What does viviparous mean?

Mother. It is derived from two Latin words, which signify to be born in a living state, and is used in contrast to *oviparous,*

* From *Carnarium,* a butcher's shambles.

the term applied to those animals that produce their young in the inanimate form of eggs.

The *musca carnaria* is supposed to produce a greater number of young than any other sort of fly; one of them, on being carefully dissected, was found to contain twenty thousand worms.

Lucy. How wonderfully small the worms must be! Indeed it seems hardly possible, that so small an animal can contain such a number.

Mother. They are not only very minute, but they are so arranged as to occupy an extremely small space. In the fly a white mass was observed, in the form of a flat band, like a ribbon, and rolled up very closely. This band was carefully unwound from its coil. At first sight it appeared as if delicately carved; but when a higher magnifying power was applied to the microscope, this appearance was found to have been caused by the young maggots, which were placed beside each other in parallel rows along

the band; the thickness of the band being just equal to the thickness of the body of one maggot.

Lucy. Just, mamma, as if a bit of penny ribbon was entirely formed of these little creatures, closely stuck together.

Mother. Very well imagined: the band was quite white in the middle of the coil, but at the outer extremity the young fry were of a pale brownish hue, and were already alive and active. As the maggots come to maturity, the band unrols; the most perfect of them are pushed off; and the fly deposits them on the flesh, where they are to live.

Lucy. But is it not astonishing how any one could dissect a fly, without destroying all this little delicate coil?

Mother. It is astonishing, Lucy; but if we admire the dexterity of those naturalists, who could unrol this wonderful web, and lay it open to our view, what ought we to feel towards that power and wisdom, by which it was constructed, which formed it of regularly organised

creatures, and which endowed those creatures with the faculties requisite to perform a useful part in the beneficent economy of the universe!

Lucy. Dear mamma, can those animals, which destroy and spoil our meat, be of any use?

Mother. There is no race of animated nature which is not in some way conducive to the general benefit. These flesh maggots are of essential service, by speedily destroying the putrid carcases of dead animals, which would otherwise be an intolerable nuisance. These worms continue their depredations for seven or eight days, and then bury themselves in some loose earth.

Lucy. Where, I suppose, they change to chrysalids?

Mother. They do so; in the progress of their change the body contracts in length, and enlarges in thickness, till it acquires the form, and indeed the appearance, of an egg; and the skin, which is at first white and soft, gradually alters to

the colour and firmness of leather. If opened while in its white, soft state, it seems to contain only a half-fluid matter, in which no trace of the future animal can be perceived; but in a few days the form of the fly may be distinguished, and in three weeks it becomes quite perfect.

Lucy. Yet these changes could not have been observed through the brown leathery skin, as in the case of some other insects?

Mother. No; the skin is too thick for that; but the person, who dissected the fly with so much nicety, was patient enough to open one of these egg-shaped chrysalids every day, by which means he was enabled to trace the whole progress and development of the fly.

Lucy. Mamma, another curious circumstance in the changes of this fly is the half-fluid matter found in the egg; for in all the other insects, which you have described, their shape was distin-

guishable, even at the beginning of their change.

Mother. The generality are certainly found to possess their proper form, in the very first stage of their transformation; there are, however, several insects, whose imago form can scarcely be discerned at the beginning of their change.

Lucy. I think you said there were other flies that were viviparous; are their little worms also twisted up in bands?

Mother. No; that circumstance is peculiar to a very few species. Let us now turn to the characteristic description of our two flies, that you may the more readily distinguish them.

Musca vomitoria, blue flesh fly—eyes brown—plumes of the antennæ branched—thorax black—abdomen dark glossy blue—legs black—length about half an inch.

Musca carnaria, flesh fly—eyes reddish—thorax black, with four grey lines—abdomen of five segments, che-

quered grey and black — legs black — length about four lines. This fly is not so broad in proportion as the blue fly, and the body has a greater curve downwards.

Lucy. I think I should easily know these flies from one another.

Mother. I hope so. Out of the prodigious number of species which belong to this tribe, there are many others worthy of your acquaintance; but we must reserve them for some future occasion, and proceed to-morrow to another genus.

Before we part, however, I will amuse you with a curious circumstance of these flesh-eating larvæ: — a celebrated foreign anatomist actually contrived to enlist them into his service.

Lucy. Oh! mamma, how is that possible?

Mother. In making certain kinds of anatomical preparations the object is to show the tendons and sinews, independent of the fleshy parts. These maggots only

eat the soft flesh, and leave untouched all the firmer substance, of which the tendinous parts are formed; even the finest membranes they strip of every particle of flesh and fat, and shew them in the highest preservation. This gentleman employed the larger species for the coarser parts, and the worms of some very small flies for eating between the delicate and close-laid fibres.

DIALOGUE XXXVIII.

CULEX, OR GNAT.

MOTHER. The genus of insects, which I have selected for our conversation this morning, is the *culex, or gnat,* an insect of which I believe you have already heard.

Lucy. That I have, indeed, and have felt them too; they are very troublesome in the evenings.

Mother. On some persons' skins they produce much pain and inflammation: and at night they are very disagreeable guests in one's bed room, from their incessant noise. The gnat always lays its eggs in pools of standing water, on the surface of which it is curious to see them

floating, their long hind legs crossed under them, while the body is kept upright by the assistance of their fluttering wings.

Lucy. Do the eggs float, or do they sink to the bottom?

Mother. They float for some days; the gnat fastens two or three hundred of them together by a glutinous liquid, and gives the whole mass the shape of a little boat, which is driven about by the wind. In a very few days the larvæ are hatched; they are very small, but well worth observing as to their form.

Lucy. Can I see them in all pools?

Mother. They are common from May till the beginning of winter in ponds and stagnant ditches, where they may be seen suspended with the tail uppermost. The head is large and scaly, with two antennæ, and several hairs, which are jointed, and always in motion; it is also furnished with two hooks, by which it seems to catch, and hold fast, its food.

Lucy. What, mamma! do such little

creatures find still smaller creatures on which they can prey?

Mother. Yes, my dear; water is thickly inhabited by *animalcula,* which are so small as to be invisible to the eye without the help of a very good microscope.

Lucy. What does animalcula mean?

Mother. An animalcule means an extremely small animal; the term is applied to those little creatures which can only be seen through magnifying glasses.

Lucy. I am very sorry to find that water is not as pure as it seems to be. We must swallow these little animals at every sup.

Mother. Certainly; and every vegetable you eat, and even the air you breathe, swarms with animalcula, but we need not let the mind dwell on such things. The water, which appeared clear and pure when you were ignorant that it contained any animalcula, is, in fact, not less so now, nor less fit for all the uses

to which it is commonly applied. When the larvæ are first hatched they are not more than a tenth part of an inch long, but they quickly grow to about the length of half an inch; within the thorax the future gnat has been traced, with its legs nicely folded up.

Lucy. Like the tiny moth, which is found inside the three upper rings of the caterpillar.

Mother. Yes; but the body of this worm is very different from that of the caterpillar; the abdomen is divided into eight rings, and from the sides of each ring three or four bristles proceed. It has also four processes, like fins, which assist it in swimming; and the tail is divided into two parts, by one of which it steers, while the other contains two breathing tubes, or stigmatæ.

Lucy. Then, I suppose, it is in order to keep these little stigmatæ above water that it hangs with its head down?

Mother. Just so; and it is enabled to

suspend itself in this position by means of an oily fluid, of which it has a small reservoir in the tail.

Lucy. How does the oil enable it to suspend itself?

Mother. Oil, you know, is much lighter than water, and swims on its surface, in a thin pellicle, or film; to this pellicle the little creature attaches itself.

Lucy. Do they never sink?

Mother. When the wind is high, and the water rough, the oil is disturbed, and they descend to the bottom; but as they seem incapable of living without a constant supply of air, they frequently return to the surface. They continue in this larva state for about three weeks, when they become pupæ.

Lucy. And then, I suppose, they immediately leave the water?

Mother. No; they remain some time longer in the water to perfect their changes; the stigmatæ, which were at the tail, are now placed at the head, and

the form of the gnat can be perceived through the shroud, or case, in which it is enveloped, and which is again wrapped in an outer case of fine net work. The pupæ float upon the water, rolled up in little spiral balls; but they have the power of unrolling, and of diving to the bottom, if alarmed. In three or four days they burst their case, and, resting on it, as on a boat, till they can expand their wings, they become at once inhabitants of the air: but this is a critical moment of their existence: should the wind be high, and the water agitated, the boat fills, and the gnat perishes.

Lucy. Well, indeed, I should not grieve much if they were all to be drowned, though they are such curious little creatures. I think the plague of gnats would be as vexatious as the plague of locusts.

Mother. But not quite so destructive. The proboscis, or trunk, is the most wonderful part of the gnat; it is composed of an outer tube, which is so flexi-

ble that it can be bent in any direction: within this there is another tube, very sharply pointed, and containing five or six minute points, which are shaped like lancets. The gnat deliberately inserts this pointed inner tube in the skin, and then darts the lancets into a small vein, at the same moment ejecting through the tube into the wound a drop of a clear liquid, which, mixing with the blood, renders it more fluid, and more easy to suck up. It is supposed that the itching and irritation, which attend gnat bites, is produced by the acrid, or poisonous, qualities of this liquid.

Lucy. Are there many kinds of gnats?

Mother. I think there are fourteen or fifteen species. One of the most troublesome is the little midge, which bites so sharply in damp evenings. The mosquito, which is so great a torment to the inhabitants of the West Indies, and of all hot climates, is a species of gnat; and the wound which they inflict is much

more severe, and the inflammation more lasting than that of our gnats; but even the coldest climates are not exempt from them. The Laplanders are so much infested by these winged tormentors, that the poor natives are often obliged to sleep surrounded by smoke, in order to keep them off.

The *culex* is thus described. Antennæ of the male feathered—mouth armed with piercers, contained in a flexible sheath—feelers two. *Culex pipiens*, or common gnat, grey—abdomen of eight segments.

DIALOGUE XXXIX.

HIPPOBOSCA.

MOTHER. The different stages, Lucy, by which insects usually arrive at their perfect state, are no doubt familiar to you by this time?

Lucy. The egg, mamma, is the first stage; from it the larva proceeds; then comes the pupa; and then the fly: but among the muscæ you said there were some kinds, which produced their larvæ at once.

Mother. I shall now describe a family, in which the animal brings forth its young in the imago, or perfect state, and of full size.

Lucy. Like calves and lambs, which are born perfect creatures?

Mother. Yes; but calves and lambs are weak and small; they are not a tenth part of the size to which they afterwards attain. Their bodies have not the same shape, or proportions, which they bear when full grown, and in some parts they are quite imperfect; as, for instance, their teeth and horns. But the animal, to which I allude, is complete, and issues full sized from the egg.

Lucy. Then the mother does lay an egg?

Mother. She does; this egg is about the size of a common pea, white at one end, and black at the other, and full as large as the parent fly.

Lucy. Then it never goes through the stages of larva and nymph?

Mother. It has been suggested, that these changes have already taken place before the egg is laid, and that the fly is then in the nymph state.

Lucy. What is the name of this curious fly?

Mother. *Hippobosca equina.* It is

sometimes called spider fly, from a fancied resemblance to a spider; others call it the horse leech, or horse fly; but all these names are improper, because they make a confusion of terms.

Lucy. How, mamma? for I have often seen brown flies, with beautiful green eyes, that sadly worried horses.

Mother. Yes, Lucy; and that affords an instance of the confusion, which calling the hippoboscæ, horse flies, would occasion, since horse fly is the name commonly given to the *tabanus*, which in summer and autumn torment our cattle.

Lucy. You did not give me any account of the tabanus.

Mother. No, I did not, because, though the fly is very common, the larva is unknown: the fly has a large proboscis, armed with a sharp lancet; it sucks large quantities of blood, and gives great pain to the creature it attacks.

Lucy. And why is it wrong to call the hippobosca a horse leech?

Mother. The leech, or *hirudo,* is an animal belonging to the class *vermes,* in which worms of all sorts are placed. It has neither eyes, legs, nor fins, and inhabits ponds and ditches; one species is called the horse leech, from its frequently attacking the legs of horses, while standing in the water: it makes a large triangular wound, and soon fills itself with blood. But to return to the hippoboscæ, which are among the most indefatigable enemies of horses.

Lucy. Poor horses, to what a number of enemies they are exposed!

Mother. In summer and autumn the hippoboscæ fix themselves on the thin and tender parts of the horses' skin, by means of their sharp claws, of which they have several on each foot; and they adhere so closely, that the poor animal bites and tears its flesh in fruitless endeavours to rub them off. Within a sheath they have a proboscis, which they can lengthen or shorten at pleasure, and which, though as fine as a hair, is strong

enough to penetrate through a horse's hide. Another species fastens on dogs, for which reason in France it is called *mouche de chien,* or the dog fly.

Lucy. Is this a very numerous family?

Mother. No; only four species have been found in England; one of these is called *H. ovina,* or the sheep tick; it is remarkably tenacious of life, and is often found alive in wool, long after it has been shorn and packed up. Another species, *H. hirundinis,* is chiefly found on swallows; it is smaller than the H. equina, but produced in the same remarkable manner. The eggs are black and highly polished, so that they look like little balls of jet.

Lucy. I should like greatly to see some of this singular tribe; will you describe them exactly to me, mamma?

Mother. Antennæ filiform — mouth furnished with a bivalve, cylindric, and obtuse beak — feet terminated with nume-

rous claws. These are the general characters of the genus; now I will give you those which distinguish the species.

Lucy. But first, mamma, what does bivalve mean?

Mother. *Bivalve* is composed of two valves, or shutters, which close together: thus an oyster, a cockle, and a muscle, are said to have bivalve shells, that is, the two parts, of which the shell consists, are jointed to one another, and shut close together.

Lucy. Thank you, mamma, I understand that very well; now will you explain obtuse?

Mother. *Obtuse* means blunt, in opposition to an acute or sharp angle. The first species, the *H. equina* *, broad, flat, and scaly—head yellow—eyes brown—thorax and abdomen yellowish, with brown waves—wings obtuse, cross each other, a brown spot near the margin, and

* From *Equus*, a horse.

much larger than the body—legs yellow and brown, armed with four claws—length two lines and a half.

The second, *H. hirundinis* *, head yellow—thorax darker—abdomen dusky, with a blueish cast, broad and flat—wings tapering, narrow, and short—legs long, each foot furnished with six claws. You see the differences are well marked, and yet each species has some characters which are common to all. Now, Lucy, our Entomology must be laid aside for to-day.

* From *Hirundo*, a swallow.

DIALOGUE XL.

ORDER APTERA. PEDICULUS, OR LOUSE. PULEX, OR FLEA.

MOTHER. To day we shall proceed to the seventh and last order of insects; it comprehends all those that have no wings at any period of their lives; and as this is the distinguishing characteristic of the order, it is therefore called *aptera*, that is, without wings.

Lucy. But, mamma, in some of the other orders there are female insects which have no wings, the glow-worm, for instance.

Mother. True, Lucy; but no apterous insects, whether male or female, have wings: nor, with the exception of the flea, do they go through the transfor-

mations, which those in the other orders invariably observe. They are born in their complete shape, and only change their skins as they increase in size. There are several genera in this order, of which very little is known: I shall begin with a family, which, though always mentioned with well founded disgust, is, notwithstanding, deserving of some attention.

Lucy. I cannot imagine what creature you mean.

Mother. Indeed it is most probable that my well combed and cleanly little girl never saw, much less felt, one of these odious little animals—I mean the *pediculus*, or louse, the scourge of filth and indolence.

Lucy. I have heard people mention a louse, but I never saw one.

Mother. The *pediculus humanus*, or common louse, multiplies at a prodigious rate. To ascertain this rate, a certain naturalist put a female into a worsted stocking, which he wore for six days and nights; at the end of that time her pro-

geny amounted to fifty, and they grew so rapidly, and so soon produced another generation, that he calculated, that one female might, in the space of eight weeks, have five thousand descendants.

Lucy. What an amazing increase! I wonder how any body can be free from them.

Mother. Constant cleanliness is the grand preservative. These insects breed chiefly in the head, because the moisture and warmth, which is usually found under the hair, is particularly suitable to their habits. When they first issue from the egg they are nearly white; but as they grow, and change their skins, they become of a dark grey tint. The head terminates in a sort of hollow snout, or sheath, containing a trunk, or sucker, which is said to be seven hundred times less than a common hair, and through which all their food is imbibed.

Lucy. It feeds only upon blood, I suppose?

Mother. Blood is its chief food, and

the skin is so transparent, that the blood may be seen to rush in a bright red stream through the trunk, into a small cavity in the fore part of the head; from thence it is conveyed into another circular cavity at the back of the head, and then through the breast into the intestine. At the end of the abdomen the intestine returns towards the breast for a short space, and in this bent part the blood is digested, that is, converted into nutriment.

Lucy. Odious as this little animal is, it would be very amusing to examine it in a microscope.

Mother. The thinness of its skin allows the inward structure and progress of the food to be observed better than in almost any other animal; even the motion of the muscles, when the antennæ, or the legs, are moved, is visible in the microscope. This species has six legs, and each foot is armed with two claws, one of which is long and curved, like the talon of a bird, the other short and

straight, so that it can grasp with them, as it were, with a finger and thumb.

Lucy. Does it prey on any other animals than men?

Mother. Yes; very generally on birds, of which almost every kind seems to have a species peculiar to itself. Cattle, even horses, are sometimes, in consequence of bad food and insufficient care, seized with the lousy disease. But let us quit this disgusting subject, and proceed to another genus, with which, I fear, you are a little better acquainted—the *pulex*, or flea.

Lucy. Yes, indeed, I have seen fleas, and felt them too.

Mother. Fleas are the only family of the order aptera, whose young, after quitting the egg, pass through the larva state.

Lucy. What little eggs a flea must lay.

Mother. They are very small and white, and so perfectly round and polished, that they would roll to the ground

were it not for the care the flea takes to place them at the roots of the hair on various animals, such as dogs and cats, or between the feathers upon birds.

Lucy. What! are the pretty little birds tormented by fleas also?

Mother. Pigeons, and most large birds, have vast quantities of fleas; and I believe few species are exempt from them. The eggs are hatched in about six days; the worms are white and shining, like mother of pearl; they have no feet, but the tail is armed with two small hooks, by which they probably secure themselves to the skin of the animal upon which they live. They have two short antennæ, and on their bodies grow a few hairs, thinly set.

Lucy. Do they remain long in this larva state before they become fleas?

Mother. About a fortnight; at the end of that time they arrive at their full size, and are very active, lively little maggots. They can creep very swiftly, with a motion like that of the silk worm,

and on the least touch, or alarm, they roll themselves up into little balls. When the larva period of their life has elapsed they spin themselves a little cocoon.

Lucy. Oh! what a diverting cocoon it must be! One must use a microscope to see it.

Mother. It spins the cocoon with its mouth, drawing the minute silken threads from a reservoir of gummy matter, with which it is provided; the outside of the cocoon is generally dirty, but the inside is as white and as soft as cotton. It remains a fortnight in the chrysalis, during which time it is white and polished, so that it looks like an ivory flea; but two days before it emerges from its case, the skin becomes gradually darker and harder.

Lucy. Mamma, I remember to have heard it said, that fleas jumped farther in proportion to their size than any other creature.

Mother. Yes; it is asserted, that a flea can jump two hundred times the height of its own body.

Lucy. How is it able to do so? Its legs must be fitted for that purpose, I suppose, like those of the grasshopper.

Mother. The grasshopper is assisted in leaping by its wings; but the exploits of the flea are entirely the result of muscular action. It has six legs, two of them are jointed to the head, and between these are placed two antennæ, or feelers, of four joints each, as well as the proboscis, or sucker, with which it pierces the skin; the other four are attached to the breast, and all the legs are divided into three principal joints. When the animal jumps it shuts up these joints close together, so that the thighs are brought down close to the shanks; and the legs are so folded, one within the other, that the effort is made by all exactly at the same moment. The lower joint of the legs is composed of four or five smaller divisions, and terminates in two sharp hooked claws, which enable it to cling securely on whatever substance it may chance to alight. Their eyes are

formed something like a cat's, and remarkably brilliant; the feelers are supposed to be, likewise, organs of smell; and two small cavities, covered with a thin film, are probably the ears.

Lucy. Mamma, I have heard that a flea has some resemblance to a lobster; but the lobster has a great broad tail.

Mother. The likeness, in shape at least, is not very perceptible; the idea has probably arisen from their scaly coverings. To the naked eye, the flea appears to be covered with one single shell; but, when examined through the microscope, the shell is found to consist of a number of highly polished plates, or scales, of a substance resembling tortoise-shell, and which are beautifully jointed and fitted to each other, like a coat of mail. The edge of each plate is fringed with a regular row of bristles, like little spears; and all these plates yield so readily to the quick motions of the flea as not in the least to impede its agility.

Lucy. How little does one imagine,

in looking at a flea, what wonders are contained in its tiny body!

Mother. Ignorance does indeed shut our eyes to the many beauties and many curiosities which are constantly before them. I have now only to add, that the proboscis is formed of a sharply pointed sheath, in each side of which there is a small slit. When our skin has been pierced by the sheath, little lancets are thrust out of the slits, and the blood, which then flows plentifully from the wound, is sucked up by the tongue, which it moves up and down inside the sheath.

The flea is thus described. *Pulex*—antennæ moniliform—eyes two—trunk taper—legs six, and formed for leaping—abdomen compressed.

Lucy. Are there many species in this genus?

Mother. Only one known in this country, the *pulex irritans.* For though the fleas on dogs, cats, birds, and men, vary a little, yet there is no essential difference sufficient to mark a distinction

of species. In the West Indies there is another species, the *P. penetrans*, or the chigoe; it has a much longer proboscis, with which it penetrates the skin, and lodges its eggs in the flesh, where they sometimes produce fatal effects.

DIALOGUE XLI.

ARANEA, OR SPIDER.

MOTHER. A very large genus of apterous insects, the *aranea*, or spider, shall furnish us with the subject of this morning's conversation: many species are found in England, and a still greater variety in the warm parts of the globe, where they grow to a great size, and some few are venomous.

Lucy. Do not our common spiders sting, or bite? most people seem to be afraid of them.

Mother. The only noxious spider with which I am acquainted is the *aranea subterranea*, or cellar spider; it is frequently found in dark and damp places, has a livid colour, and is armed with

strong pincers. Some years since one of that species pinched my arm; the pain was transient, but a red bump was raised, which remained for four or five hours. Such wounds, however, are not very alarming; nor can you rationally dread an animal, which inflicts them only in self defence. None of the common house or garden spiders have either the inclination or the power to hurt.

Lucy. I am very glad to know this, because it is so pleasant to get rid of one's foolish fears; and I like watching the pretty green and yellow spiders, which I find among my flowers.

Mother. This genus is so numerous, that it has been divided into fifteen families, which are distinguished by the varieties in the position of the eyes. One of these divisions contains those which have only six eyes, but all the others have eight, though differently placed.

Lucy. Eight eyes! five is the greatest number you have yet described in any insect; that is, the two large reticulated

eyes in the face, and the three stemmata, or little single eyes, on the top of the head.

Mother. You are right; but the spider is not able to turn its head: and being obliged to exert great vigilance to entrap its prey, as well as to guard against the attacks of numerous enemies, such as birds, ichneumons, and other large insects, it has been furnished with these additional means of perception. The eyes are immoveable, and, like the stemmata, each is formed of a single lens. Though placed in different relative situations on the top, in the front, and on each side of the head, yet the two eyes, nearest to the mouth, always project and incline forward; while another pair project and incline backwards.

Lucy. So that the creature can see in every direction: no wonder that it can so quickly pounce on the poor flies.

Mother. It has also eight legs, of different lengths, in each of which there are three joints; and the feet terminate in

crooked claws, which enable it to climb with so much agility. It is furnished with a pair of sharp strong pincers, in order to seize its prey; and when these are not in use, they lie folded up in two hollow cases, as a knife shuts into the handle. There is no division between the head and the thorax, which is attached by a slender tube to the abdomen. The abdomen is very large in proportion, and contains a plentiful store of glutinous matter for the construction of the web. This substance the spider ejects from five little *tubercles*, or prominences, which are perforated with innumerable and very minute apertures, and on being exposed to the air it quickly dries, and forms the threads of which the cobwebs are woven.

Lucy. How do spiders make their webs, and fasten them to walls, or other things?

Mother. When a spider has fixed on a suitable situation, such as the corner of a room, for instance, it presses the little tubercles against the wall, and thereby

glues to it the ends of the threads; it then runs along the other wall, drawing out the threads as it moves; and at a convenient distance they are pulled tight, and fastened by glueing: thus it proceeds, alternately, backward and forward, from wall to wall, till the web is of sufficient size and strength. The first two or three journeys are made on the walls, but afterwards the spider walks on the threads, though newly spun, by which means it can attach the cross threads, and thus the web is completed.

Lucy. If I were to press the tubercles with my finger, could I draw out a thread?

Mother. Yes; out of each tubercle you would draw a thread, apparently single to the naked eye; but when seen through the microscope, it is found to be composed of a vast number of smaller threads, which unite at a short distance from the apertures.

Lucy. Something like the silken

threads, which are wound from several cocoons, to form one of sufficient size for our use?

Mother. Much in the same way. When the web is large you will sometimes perceive, that the outer edge of it is supported by long threads, fastened to the ceiling, or carried several feet up the wall. Spiders change their skins more than once; for this operation they retire into some snug nook, where they suspend themselves: in a short time the skin splits along the back; the spider first draws out its body at the opening, and then its legs, one by one, leaving behind the old transparent skin, which is frequently found entangled in the web.

Lucy. Do spiders come from the egg completely formed?

Mother. Yes, they do; the only alteration that takes place is in colour, which generally varies with each change of skin.

Lucy. Mamma, I have seen brown

spiders with round blueish bags fastened to them, and these I have been told were bags of eggs.

Mother. Several species of spiders weave a bag to contain their eggs, and carry it till they are hatched. No animals show greater attachment to their progeny; they would rather lose their lives than these precious bags, and often fall a sacrifice to the obstinacy with which they defend them from more powerful insects, and even from birds.

Lucy. How very strong the threads of those webs must be which catch large flies! Could not something be made of them?

Mother. The experiment has been tried in France, and a pair of stockings was actually made of the egg bags; the colour was a glossy grey, and in strength they were but little inferior to common silk.

Lucy. What prevented their making more than one pair? I am sure there

are plenty of spiders in this country, at least, to make stockings very cheaply.

Mother. When a great number were collected in order to spin, it was found difficult to preserve them; the strong devoured the weak, so that out of fifty, which were put into one place, there remained, in a few days, only the two largest, though they had been plentifully supplied with flies and with the pith of quills, of which they are extremely fond. The consumption of web also was enormous: to make one pound of silk it required the work of fifty-five thousand female spiders, of the largest species.

Lucy. I see it was a hopeless business, indeed.

Mother. Now, my little girl, I am going out; to-morrow we shall finish the history of the spider.

DIALOGUE XLII.

ARANEA, OR SPIDER, CONTINUED. A. AVICULARIA. A. FASCIATA. A. DIADEMA. A. AQUATICA.

LUCY. See, mamma, what a huge spider I have under this wine glass.

Mother. Yes, it is rather a large specimen of the common house spider, or *aranea domestica*, whose manner of constructing its delicate web I described to you yesterday; but it is very inferior in size to some foreign species. For instance, Sir George Staunton mentions a native of the island of Java, in the East Indies, the texture of whose web was so strong as not to be divided easily without a knife, or some sharp instrument.

Lucy. What is the size of the largest

spider that has been found in any country?

Mother. The body of the *aranea avicularia* is said to be larger than a goose's egg; it is covered with long black hair, and its bite is very venomous. It is a native of the forests of Brazil, where it spreads its nets from tree to tree, to catch not only insects, but even small birds; and from this circumstance the specific name has been derived*.

Lucy. How fortunate we are, mamma, in not having any of that terrible spider in this country!

Mother. Another large species, the *aranea fasciata*†, chiefly found in Barbary, is almost the size of a man's thumb; the meshes of its net, which it spreads over a bush, allow small insects to pass through, but they are strong enough to entangle the larger flies, wasps, and even locusts, which it speedily kills. Having

* From *Avis*, a bird.

† From *Fascia*, a band; its abdomen being marked by a yellow stripe.

SPIDERS.

Aranea Aquatica.

Aranea Diadema.

Aranea Tarantula.

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eaten as much as satisfies its hunger, it carefully deposits the remainder of its prey in a little storehouse of dry leaves, over which it spins a strong black web.

Lucy. So this species actually keeps a larder full of provisions?

Mother. The warm parts of Europe produce a spider called *aranea tarantula**; its dwelling is formed in the ground, about four inches deep; and this apartment is half an inch in breadth, lined with silk, and closed at the mouth with a net. It is said to lay about seven hundred eggs. Its bite occasions severe inflammation; and wonderful, but now exploded stories have been told of the power of music in allaying the madness, which it was supposed to produce.

Lucy. Which is the largest spider found in England?

Mother. The *aranea diadema*†, so called from the spots on its back bearing a slight resemblance to a crown, or dia-

* From *Taranto*, a city of Italy. Plate XXIV.

† Plate XXIV.

dem. This species spins a curious net, which may be often observed extended on shrubs and palings; it is composed of very strong threads, disposed in concentric circles, one within the other, and crossed, at regular intervals, by other threads, as radii. You understand the meaning of radii?

Lucy. Oh yes; papa showed me a circle, and drawing a straight line from the centre to the outer edge, or circumference, he told me that it was called a radius, and that more than one were called radii.

Mother. Very well. These radii, and the several circles, are glued to each other at the points where they intersect, or cross, and thus form a firm and tenacious web: but there is a curious circumstance in this creature's habits: the inner circles are broken off every morning, and replaced by fresh threads.

Lucy. Why does it take such unnecessary trouble, mamma?

Mother. The glutinous substance, of

which its web is composed, dries very gradually; and as this clammy quality assists in catching those flies, which otherwise might force themselves through, the sagacious animal daily renews such of the circular threads as are best adapted to that purpose.

Lucy. And I suppose the radii are not renewed, because their chief use is to keep the web steady?

Mother. Just so; the *aranea aquatica**, or water spider, is another remarkable species, and is found in most parts of Europe. It lives at the bottom of fresh waters, where it has the brilliant appearance of silver; but this effect is produced by a bubble of air, in which it is enclosed.

Lucy. I suppose, mamma, that, like the fan-tailed larvæ, it cannot live under water without a provision of air; but how does it manage to confine the air there?

* Plate XXIV.

Mother. The spider weaves a loose elastic bag, which is secured to the ground, at the bottom of the water; and by a coat of transparent varnish, it renders this bag air-tight. Then, rising to the surface of the water, and sucking in a portion of air from the atmosphere, it returns to the bottom, introduces the air into the bag, and again ascends for a fresh supply; repeating this process till the bag, or air-chamber, is sufficiently distended. There the spider lives; it can go out at pleasure to seek its prey, but returns home to devour it at leisure.

Lucy. I suppose these spiders feed only on the little creatures, which are found in the water?

Mother. They hunt on dry ground with equal ease, but they always dive, with whatever food they procure, to their aerial abode in the water.

Lucy. Is not that beautiful shining silk, with which the fields are sometimes covered, made by a spider?

Mother. Yes; the gossamer, which

floats in the air, and which forms such a brilliant net work on the grass, when loaded with dew, is the work of a little field spider.

Lucy. I suppose, mamma, that the threads we see on the grass serve for bridges for these little creatures, and must save them a great deal of trouble in climbing; but what can be the use of the immense quantity which blows about in the air?

Mother. This spider has the power of throwing out its threads to a considerable distance. Some of these attach themselves to the blades of grass, either by their own glutinous nature, or by the rough edges of the leaves; and, being immediately pulled tight by the animal, form what you call its bridges. But it can also shoot its long threads upwards into the air, and then, suddenly springing in the same direction, it is borne away by the wind.

Lucy. The history of the spider fa-

mily contains a number of wonderful circumstances, indeed.

Mother. There are upwards of one hundred and thirty species in this family, and the contrivances of each of them, in arranging and repairing their nets, and their ingenious stratagems in ensnaring their prey, will be an inexhaustible fund of amusement to you hereafter.

DIALOGUE XLIII.

CANCER, OR CRAB. C. PAGURUS, OR COMMON CRAB. C. BERNHARDUS, OR HERMIT CRAB. C. PINNOTHERES.

MOTHER. This morning I shall entertain you with the genus of *cancer*, or crab.

Lucy. The crab! I always thought crabs were fish, and not insects.

Mother. No, Lucy, they are not fish; nor indeed are they insects, according to the arrangements of modern naturalists, who have removed from that class many of the animals which it formerly contained. For instance, the last great family we described, the spider, has

been placed in a new class, *arachnides;* and crabs, lobsters, cray fish, prawns, centipedes, in short, the whole genus of cancer are now transferred to a class, called *crustacea.* As these animals, however, have antennæ, palpi, and jointed bodies, they were considered by Linnæus as apterous insects; and as we have hitherto followed his classification, we may as well include them in our little course.

Lucy. Pray do, mamma; it will be very pleasant to know something of creatures which I see so often. But how can such large creatures as crabs and lobsters be called insects?

Mother. The species with which you are acquainted are large, but there are others that require a miscroscope to discover their structure. The *cancri* have four antennæ placed below the eyes—six palpi of unequal lengths, the four longest of which cover the mouth—two moveable eyes, projecting from the head, and ge-

nerally placed at the end of pedicles—legs six, eight, or ten, besides two arms, terminating in *chelæ*, or claws.

Lucy. These arms are, I suppose, what we call the large pinching claws?

Mother. Yes; in the *cancer pagurus*, or common crab, they are very powerful; and it exerts them with such force and obstinacy, as to allow the arm to be sometimes torn off rather than loose its hold. Crabs live many years, and annually change their shells; previously to that operation they retire into the sand, and remain there till the new shell is hard enough to afford protection. In that soft state, however, they fall a prey to many other creatures, and numbers are destroyed by fishermen, who use them as bait.

Lucy. But how can fishermen find them, when hidden in the sand?

Mother. A considerable number usually retire together; and as they are weak and defenceless while soft, they place a hard-shelled crab as a sentinel. Though

the crab commonly appears to be a timid animal, yet on these occasions it acts a very courageous part, and generously defends its friends from fish and insects; but the fishermen, by observing where these guards are stationed, are able to discover the soft crabs. In winter the crab is seldom found, but in summer it inhabits all our rocky shores, generally preferring those rocks which are about twenty fathoms under water.

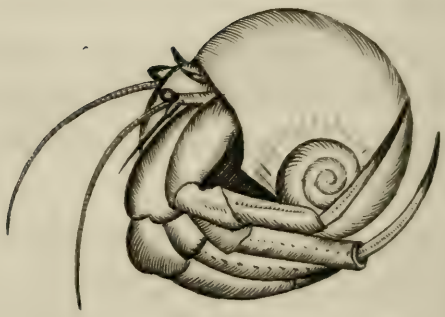
Lucy. How much is a fathom, mamma?

Mother. A fathom is two yards, or six feet; therefore twenty fathoms is a hundred and twenty feet.

Lucy. I cannot imagine how crabs are caught at such an amazing depth.

Mother. They are taken in traps made of wicker work, and baited with refuse meat, of which they are very fond. These traps are sunk to the bottom of the sea by large stones, and a rope is fastened to each of them, with a buoy to mark its place.

Cancer Pinotheræ
the
Muscle Crab.



Cancer Bernhardus
the
Hermit Crab.

Published November 1, 1818, by R. Hunter, St. Paul's Church Yard, London.

Lucy. Are there many sorts of crabs that are used as food?

Mother. In proportion to the number of species, which amount to nearly two hundred, there are not many that are reckoned wholesome: the hermit crab, sometimes called *cancer bernhardus,* and sometimes *cancer diogenes**, is said to be one of the best. It inhabits the woody shores of the Indian seas, and subsists on berries and other vegetable produce. I have heard that it gives a feeble cry when caught. This curious animal inhabits the deserted shells which lie on the shore, and generally chooses one a little larger than necessary, in order to allow for its own growth.

Lucy. I suppose it merely sleeps in the shell at night?

Mother. No; this little Diogenes also carries his house with him, and never deserts the old shell till he has found a new one more to his liking.

* Plate XXV.

Lucy. Mamma, to what other Diogenes do you allude?

Mother. Diogenes was an ancient philosopher, who affected to despise, not only the luxuries, but all the comforts, of life; and, amongst other singularities, chose to make a tub his abode, which he constantly rolled about with him.

Lucy. So then this crab is called Diogenes, because it carries its house with it?

Mother. Just so; and when it has outgrown its house, it may be seen running along the sea beach, and examining all the shells, and even trying them on; till at length, finding one large enough for complete concealment, and light enough to be conveniently carried, it abandons its old tenement.

Lucy. But if two crabs happened to fancy the same shell, how would they manage?

Mother. They would decide the point in dispute by a regular battle, striking and pinching each other with their claws

till the weakest is obliged to yield: the conqueror then takes possession of the prize, and often parades it in triumph before his disappointed adversary.

Lucy. It seems odd that crabs should want a house, when their own shells are so hard.

Mother. There are several kinds of thin-shelled crabs that also seek for shelter; but it is indispensable to the Diogenes, as he is only partly covered by his coat of mail; the tail is very tender, and terminates in a hook, by which it keeps a secure hold of its house.

There is a curious, but somewhat doubtful story told of a very small species of this family, the *cancer pinnotheres* *; it is said to live along with the muscle, in its shell; and this sluggish animal being too stupid to watch the approach of its prey, its lively friend, the crab, repays its protection by giving it

* Plate XXV.

due warning; the muscle then closes its shells, and secures its food.

Lucy. I think it is but fair that the muscle should be rewarded for the shelter it gives to its little guest.

Mother. On the coast of America a species of small crab is found, which preys upon muscles and scallops, by an ingenious stratagem. It watches till they open their shells, and then dexterously pops in a small stone, which effectually prevents their closing: it then sociably summons its friends to the feast, and they devour the poor animal at their leisure.

Lucy. They are really clever little creatures. Indeed, mamma, I find the crab almost as entertaining as I thought the spiders.

Mother. There are many singular facts related of the different species: the history of the land crab will, I think, interest you.

DIALOGUE XLIV.

CANCER CONTINUED. C. RURICOLA, OR LAND CRAB. C. GAMMARUS, OR LOBSTER. C. SQUILLA, OR PRAWN. PRAUNUS FLEXUOSUS.

MOTHER. The land, or violet crab, named *cancer ruricola**, is found in the Bahama islands, and in many of the tropical countries: it chiefly inhabits the mountains, or conceals itself in clefts of rocks, or sometimes burrows in the ground. But the most singular characteristic of this animal, is its annual journey to the sea shore, in order to deposit its spawn.

Lucy. What does spawn mean?

Mother. The eggs of fish are generally so called.

* From *rus*, country; and *colo*, to inhabit.

Lucy. And the eggs of frogs too, I suppose, mamma; for I have often heard of frog spawn?

Mother. Yes. About April the land crabs come forth from their retreats, and assemble in amazing numbers; they commonly divide themselves into three parties; the foremost is composed of the males, which are the strongest; the second, of the females; and the third consists of weak, and the stragglers. Thus they proceed towards the sea, and always contrive to take the shortest and straightest line, turning neither to the right nor to the left.

Lucy. But if a house, or wall, should stand in their way, what would they do then?

Mother. They would make every attempt to scale it, and would not deviate from their route, till it was evident that the obstacle was insurmountable. As they travel only during the cool of the night, and in showery and damp weather, they are a long time in reaching the shore,

from the slow and orderly disposition of their march; and, if they are suddenly alarmed, great disorder ensues, some endeavouring to retreat, and others holding up their claws, and clattering their nippers in a threatening manner.

Lucy. What a scene of confusion that must be! How they must tread over, and hurt, and pinch, each other!

Mother. Yes; and if any of them are maimed, or become too weak to proceed, they are immediately devoured by their neighbours. Sometimes it takes them two or three months to reach the coast; but the moment they arrive, they hasten to the margin of the sea, and deposit their spawn in the water, leaving to chance all future care of it. Large shoals of fish instinctively assemble near the shore at this time of year, to feed upon these eggs, and by far the greatest part of them is instantly destroyed.

Lucy. So that after all the pains these poor travellers have taken, scarcely any of their young escape?

Mother. A sufficient number of eggs are thrown up by the waves on the sand, where they are quickly hatched; and, in a short time, a multitude of little crabs are seen slowly journeying up the country to the hills. In the mean time the old crabs, having been too much fatigued to return immediately, secure themselves in holes in the earth; there they cast their old shells, and remain concealed till their new covering has acquired a certain consistency. They begin then to travel homeward to the mountains, and at this period, having grown fat, while at rest, they are reckoned very good eating. They are shaped like our common crab, and but seldom exceed six inches in breadth: some are dark, some are light coloured, and others variegated.

Lucy. Are there many other species that live on shore?

Mother. Very few; and they differ but little from the ruricola.

The next species of the cancer family, which I shall describe, is the *cancer gamma-*

rus, or common lobster. Its usual resort is in the neighbourhood of rocks, and as the water there is generally very clear, its habits have been more easily observed than those of most animals that live at the bottom of the sea. Lobsters change their shells annually, during which process they withdraw for security into crevices of the rock, that, while in a soft state, they may avoid their numerous enemies; and among these may be reckoned their own species, who eat them with as much indifference as any other kind of prey. This state, however, lasts but a very few days, as the new shell hardens rapidly.

Lucy. And then they may boldly come out of their hiding places, I suppose?

Mother. Certainly. The female lobster produces about twelve thousand eggs during the spring and summer, and places them in the sand, where they are very soon hatched. The larvæ have much the appearance of tadpoles, and in that state

may be found swimming in the little pools, which the ebbing tide leaves in the hollows of rocks. You may often see there, also, small, but completely formed, lobsters, of half an inch in length.

Lucy. What pretty little red creatures they must be!

Mother. Lobsters become red by boiling; but when alive their colour is black, or black beautifully mottled with blue. They run very swiftly on their small legs, and, if much alarmed, can spring, tail foremost, to a distance of thirty feet, and repeat these leaps with surprising rapidity. They have been seen, by fishermen, even to spring from a great distance into holes in the rock, though the apertures were barely the breadth of their bodies.

Lucy. Mamma, I think fishermen must be greatly amused in observing these wonderful things.

Mother. Intelligent people, of all professions, must, no doubt, derive enjoyment from observing the suitable ha-

bits and qualities with which the meanest animals are gifted.

Lobsters have the power of casting off a claw, if caught by it; and they frequently lose one in fighting, and by various accidents; it is even asserted, that the noise of very loud thunder, or of cannon, if close to them, occasions the loss of some of their limbs; but this is of little importance, as they are reproduced in a short time.

Lucy. Has the cray fish, when alive, the same colour as the lobster?

Mother. Its colour is of a dark brown, almost black; it burrows in the banks of rivers, and only comes abroad at night, in search of food; it is named *cancer astacus.* Two other species, with which you are well acquainted, are cancer *squilla*, the prawn, and cancer *crangon*, the shrimp. I will mention one more species of this family, from a curious circumstance in its conformation; the female is provided with a pouch, in which she carries about

her young till they are able to take care of themselves.

Lucy. Oh, mamma, it should be called the water opossum. Do not you remember among the prints in Bewick's Quadrupeds, the little creatures hiding in their mother's pouch?

Mother. Yes, I do; and I am very glad to find that you can so quickly recollect, and apply, the knowledge you have obtained. This animal has been lately discovered by Dr. Leach; it is placed among the crustacea, and named by him *praunus flexuosus.* You have now had enough of crabs and lobsters, so go and take your walk.

DIALOGUE XLV.

CONCLUSION.

MOTHER. I am delighted, my dear Lucy, to find that our Conversations on Insects have afforded you so much pleasure. They must now conclude.

Lucy. Oh, mamma, that is a sad disappointment indeed. I imagined that I had a great deal more to learn.

Mother. So you have, Lucy; for from each order I have made but a very few selections, and in those few I have entered but slightly into the details.

Lucy. When shall I learn the history of those species, which we have passed over?

Mother. When you are older: we

will then go through a more extensive course, and study each part of it with more accuracy than would have now suited your young head. In the mean time you must endeavour to keep up the information you have already obtained: nature is before you, and I shall be ready to assist you in observing the habits, and examining the structure, of our common insects. I will also point out to you, from time to time, instructive passages in various books, on this subject: but there are other subjects to which I should wish at present to turn your attention: botany, for instance.

Lucy. Well, mamma, I am sure you can make any subject agreeable; and, indeed, I am very fond of my little flower garden; but as to botany, I fear it will be very dull work. I have seen both Fanny, and my cousin Sophy, sit poring over flowers and tearing them to pieces, and every piece they called by some hard name; and then they look in their books;

and after all I hear them say, they are not sure they have found out the right name of the plant.

Mother. Have not you learned several hard names during our conversations?

Lucy. Oh yes; but you told me those Latin and Greek names were very useful, as they enabled people of every country to understand each other's descriptions.

Mother. The use of scientific terms is not confined to Entomology; it extends to all sciences, and they are not more difficult, or more dull, in one science than in another.

Lucy. No, mamma, I suppose not; but then the tearing the flowers to bits—

Mother. Is for the purpose of examining their form; for by the arrangement of their several parts, the class and family of the plant is known; just as the structure of the wings, or of the elytra, guides us in placing insects in their proper orders.

Lucy. Yes, and the antennæ, and feet, and thorax, in the proper genera. But

of each insect, you know, you gave me a a most entertaining account—not the name alone.

Mother. Nor in teaching you botany should I give you merely names; I should begin as I did with Fanny, and she was very much interested. I explained to her the growth of plants from the seed; their general structure; and the probable use of each part.

Lucy. Oh, mamma, I should certainly like to know all that: indeed you are very good to bear with all my nonsense. When shall we begin? I dare say I shall find more amusement in botany than I imagined.

Mother. Amusement, of which you so often speak, is not the only object I have in view.

Lucy. You wish, at the same time, to instruct me in what you called the different kingdoms of natural history?

Mother. I do; but there is a still higher object, one of far more consequence than the clearest and most extensive

knowledge of the whole circle of natural history?

Lucy. What is that?

Mother. It is to lead your mind, from the works of God, to God himself. Thus, in examining the smallest plant, or the most diminutive insect, I wish you to reflect on the power which created it; which adapted each part to its precise purpose; and which suited the form and faculties of every creature to the way of life it was destined to pursue.

Lucy. Yes, mamma, even those tiny animals, which can only be distinguished in the microscope, seem to be as perfectly made as the largest creatures.

Mother. The same perfection is found in every part of the creation; and the more profoundly they are scrutinized, the more conspicuous will be that perfection. Among the insect tribes, which we have been studying, observe how admirably their wants are provided for, and their means of safety secured. The spider, for example, is enabled to construct a

web to entangle its prey, because its motions are not sufficiently quick to catch the winged creatures on which it chiefly feeds; and it is furnished with numerous eyes, that it may not only detect the movements of its enemies on every side, but that it may watch the success of its own snares.

Lucy. Oh yes, mamma; and pray recollect the flat head, and shovel feet, with which the formica leo makes its trap for the poor unsuspecting ants, while it lies snug and safe at the bottom of its funnel. I can remember a great many other curious contrivances, which you have described.

Mother. To all animals you will find, that sufficient faculties have been allotted for obtaining their prey, and for escaping from those that prey on them.

Lucy. But there are some insects that do not prey on others; the harmless caterpillar, for instance.

Mother. True; yet they cannot be called harmless, when we consider the

havoc they commit on vegetables. To prevent their numbers increasing beyond a due proportion, they are made the favourite food of birds, as well as of insects; while on the other hand, lest they should all be destroyed, they also have means of eluding their pursuers.

Lucy. Yes, I recollect; many caterpillars are the same colour as the leaves, or twigs, on which they live; some can suddenly drop, by a thread, into the air; and others conceal themselves under the bark, and feed only at night.

Mother. You see how carefully Providence has attended to the preservation of all his creatures, even the most insignificant insect. Can we, then, who are the first of created beings, can we, even for a moment, lose our confidence in the protecting goodness of God?

Lucy. No, indeed, mamma; the study of all those surprising little creatures, to which you have introduced me, would be, I think, a complete cure for any

want of confidence in God. But why do you call us the first of created beings?

Mother. Because mankind, alone, has been gifted with reason.

Lucy. Yet I have heard many stories of dogs, and also of elephants, which show that they are very sensible.

Mother. There is an essential difference between the reason of man, and the utmost sagacity of other animals, namely, the capability of self-improvement: our knowledge is always progressive, whereas their instinct never passes the bounds prescribed to it by Nature.

Lucy. And are not we, also, the only animals that can speak?

Mother. Some can be taught to pronounce a few words; but no other animal can freely communicate its ideas. The strongest proof, however, of the superiority of man, is, that he alone, in contemplating the power, and in feeling the goodness, of God, is privileged to look forward to another world, and is en-

couraged to fit himself, by his conduct here, for more elevated enjoyment hereafter.

Lucy. Indeed, mamma, these reflections must add great interest to the study of natural history.

Mother. Yes, my dear child: and I would therefore earnestly exhort you, in all your studies, to keep these considerations uppermost in your mind. Without them the most extensive knowledge is unprofitable; combined with them, it becomes true wisdom.

"Oh Lord, how wonderful are thy works; in wisdom hast thou made them all!"

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